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REPORT OF THE FORESTER.

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., October 6, 1921.

SIR: I have the honor to transmit herewith a report of the work in the Forest Service for the fiscal year ended June 30, 1921.

Respectfully,

WILLIAM B. GREELEY,
Forester.

Hon. HENRY C. WALLACE,
Secretary of Agriculture.

NATIONAL FORESTRY POLICY.

During the fiscal year 1920 the Forest Service was largely instrumental in bringing before the people of the United States our present serious situation as to timber supply. Its outstanding points are the disappearance of three-fifths of the virgin forests of this country, a present drain upon our remaining forests over four times their yearly production of wood, and the accumulation of enormous areas of denuded and idle forest land. The past year has been notable for general discussion of the forest situation, in both its national and local aspects, and the consideration of remedies. To a considerable degree this discussion has centered around two proposed measures of Federal legislation. The first of these, known as the Snell bill (H. R. 129), contemplates, among other things, an extension of public control over private forest lands under the police powers of the several States, with the Federal Government functioning as a cooperating and standardizing agency. The second measure, known as the Capper bill (S. 1345), proposes the exercise of direct Federal control over private forest lands through the medium of taxation on forest products. The two measures agree in promoting organized protection from fire over all classes of forest land in the United States, by State agencies, with financial and technical cooperation from the central Government.

The year has been equally noteworthy in the advances made in forestry legislation and constitutional provisions by a number of States. Among these may be cited the clause in the constitution recently adopted by Louisiana which empowers and directs the State legislature to enact such laws as may be necessary to conserve

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the forests and other natural resources of the State and to prevent their wasteful use. The exercise of State police power over private forest lands has been strikingly asserted by laws of Louisiana and New Hampshire which require lumber operators on pine lands to leave and protect at least one seed-bearing tree per acre. The legislation dealing with the disposal of slashings in lumbering operations, as an essential phase of reforestation, has been strengthened in Massachusetts through a new law which authorizes the commissioner of conservation to require the complete removal of slashings on a strip 40 feet in width along all highways and railroads, around sawmills and logging camps, adjoining the boundaries of property holdings, and around the edges of each season's logging operation. A number of other States have also strengthened or extended the authority of their forest agencies in connection with the disposal of slashings, whose presence on logged-off lands is one of the most serious causes of destructive forest fires and lack of reforestation.

Following the survey of the remaining timber supplies in the United States and their rate of depletion, which was set forth in the report on Senate resolution 311, the Forest Service has initiated this year a second important step toward the restoration of America's forests. This is a comprehensive study of the requirements in protection and reforestation necessary to keep forest lands productive in each important region of the United States. This study has been undertaken in cooperation with State foresters, timberland owners, representatives of forest industry organizations, and forest schools. Its purpose is to put in concrete terms just what "forestry regulations" mean, in the southern pine belt, the Appalachian hardwoods, or the Lake States. Instead of dealing in general terms, it will bring the forestry movement down to specific things which are to be done in the woods, as minimum standards. It will thus serve as the basis for any plan of public regulation of forest lands and also aid the landowner who undertakes the growing of timber crops on his own initiative.

It is increasingly evident that, whatever legislation may be enacted and whatever governmental agencies may be invoked, two principles must be recognized in putting the United States upon a self-sustaining basis in timber products. They express the unavoidable logic of the situation from its public and private aspects. The first is that, because of the long-term nature of timber crops and the foresight necessary to meet future national needs, the public has an interest in forest lands not common to most forms of private property and more comparable to its interest in the operation of recognized public utilities. This public interest must be satisfied in the manner of handling forest lands. The second principle is that the production of timber is an economic process, governed by economic laws. Hence, the requirements imposed upon forest owners by the public must be equitable and practicable from a business standpoint, or must be accompanied by compensating features which make compliance a reasonable undertaking for the owner of the property.

The State or the Nation may rightfully insist that forest lands be productive rather than idle; but in so doing it can not avoid its own responsibility for reducing the general risks and losses attendant upon timber production, which have often made it a hazardous or unprofitable undertaking. The two outstanding respects in which public cooperation with the land owner is necessary, as a corollary to

regulating the use of his property, are organized protection against forest fires and the adjustment of taxes on timber lands so as to encourage their employment for growing sucessive crops.

The final working out of this important problem will take much time and probably will not be accomplished under any single piece of Federal legislation. Our effort, nationally and locally, must develop step by step. The subjects for Federal legislation now most urgent are:

(1) The extension of Federal cooperation in the protection of all classes of forest land from fire, in conformity with standards fixed by the Secretary of Agriculture. Such cooperation should not be limited to the watersheds of navigable streams, as at present, but should be available on all forest lands within the States prepared to join in cooperative effort.

(2) The extension of public forest ownership by incorporating within National Forests the public lands now under Federal ownership or control which are adapted primarily to growing timber or the protection of watersheds; by acquiring cut-over forest lands within or adjoining National Forests, through exchanges; and by purchasing forest lands with a view both to the protection of navigable watersheds and to the restoration of forests on areas now denuded and idle.

FORESTRY IN ALASKA.

There is much current discussion of the administration of public affairs in Alaska. In considering ways and means for bettering conditions in the Territory, it is important that we do not lose sight of the bearing of her resources upon the national timber supply. The National Forests of Alaska contain 20,000,000 acres and over 75,000,000,000 feet of timber of a quality suitable for general consumption. This is equivalent to nearly 6 per cent of all the timber in the continental United States. It includes 100,000,000 cords of pulpwood, whose serviceablity for the manufacture of paper is fully established by existing commercial practice.

Except where partially covered by National Forests, all of the other timbered regions of this country have been or are now being exploited in the unrestrained interest of immediate commercial profit. While in the main a necessary economic process, this form of exploitation has largely wrecked the productive power of our forest resources. To-day the country is paying the piper. And under the pressure now felt, the public must step in and seek, by one means or another, to gather up the remnants and by slow and costly effort restore the productive forests which our feverish and short-sighted exploitation has destroyed.

For the first time in our history we have an opportunity, in Alaska, to guide the development of an immense forest region from the standpoint of permanent national interest. This does not mean putting the forests of Alaska under lock and key. It means the expansion of her forest industries as rapidly as there is a market for their products, but within the limits and under the control necessary to keep the land productive and make the supply of raw material for manufacture into lumber and paper perpetual. Wisely handled, a paper industry can be developed in Alaska as permanent as the paper industries of Scandinavia, and capable of supplying a

third of the present paper consumption of the United States. This is an opportunity which should not be thrown away by inviting unrestrained and destructive exploitation. Alaska 30 or 40 years hence should be a second Norway, with permanent mills supported by an assured supply of timber and with stable industrial communities, not as the Lake State pineries of to-day, with millions of acres of idle forest land strewn with abandoned mills and dead or dying mill towns.

There has been much loose and ignorant criticism of the National Forests of Alaska as imposing bars and locks upon the development of her timber resources. Since these National Forests were placed under administration in 1906 they have been open freely for the use of timber and other commercial resources under regulations of an exceedingly liberal and simple character. They are being cut to-day to the extent of about 45,000,000 board feet of timber annually. They furnish 86 per cent of all the timber used in the Territory. They supply every sawmill on the Alaskan coast with its logs. They furnish a large proportion of the piling, lumber, and box shooks used in Alaska's fish industry. They supply the great bulk of the timber used in the mines in their portion of the Territory. Sites have been readily and freely obtained within them for a large number of salmon canneries, other fish industries, sawmills, villages, fox farms, and commercial establishments of every character adapted to this region.

The Forest Service has labored steadily to promote the establishment of a paper industry in Alaska, which promises to be one of its most important industrial developments. The governing factors in the success of this effort have been and always will be the market and transportation conditions controlling Alaskan products. The terms offered by the Forest Service to paper manufacturers in Alaska are, indeed, more flexible and more favorable to the operator than in the case of any public timberlands in Canada, with which comparisons have frequently been drawn. By allocation of timbered areas to manufacturing sites, the paper maker in Alaska is assured of a perpetual supply of raw material for his industry, with an initial contract and reservation which may cover as much as 45 years' supply for the plant proposed. Payment for this timber is required only as it is cut; and while price adjustments at five-year intervals are provided for, they are limited in all cases to the current market value of such material in the Territory. An extended program of timber and water-power reconnaissance to obtain the essential information needed by prospective manufacturers is in progress. Two sales of pulp timber, aggregating 700,000,000 feet, have been made, and there are many pending applications and inquiries from responsible sources. The actual development of a paper industry in Alaska rests upon the general financial conditions in the United States, the paper market, and transportation facilities in Alaskan waters. Just as rapidly as bona fide undertakings for the building up of forest industries in the Territory take form, they are receiving and will receive every form of encouragement from the Forest Service consistent with the public interest in maintaining permanent production from Alaska's forests.

The primary needs of Alaska are transportation, particularly adequate marine transportation, and a decentralized administration of

public resources and affairs in the Territory itself. The evils of red tape and delay are inevitable if administrative jurisdiction is retained in Washington over matters which should be dispatched by resident officials in Alaska. The National Forests of Alaska have always been administered in all respects, except the more important transactions and questions of policy by supervisors and rangers in the Territory. In recognition of the need for the fullest decentralization, however, a separate National Forest district covering the Territory was created on January 1, 1921, under the direction of a resident district forester. Ninety-five per cent of the business on these National Forests does not pass beyond Alaska, with the exception of matters involving land titles where existing law requires reference to Washington.

A further step is desirable. There is need for correlating closely the local administrative activities of the Forest Service with those of other Federal agencies in Alaska and of the Territorial Government for settling currently any questions of overlapping jurisdiction and for securing coordinated action as new developments involving different agencies present themselves. This can be accomplished readily by organizing the chief local administrative officers of the Federal Government, together with the governor, into an Alaskan council. The existence of such a body could not fail to facilitate the efforts of the Forest Service to make the National Forests in Alaska as beneficial as possible to the people of the Territory.

At the same time the administration of these Forests must also take cognizance of the fact that Alaska is part of the United States. Her forest resources are part of our national forest resources, just as her agricultural problems are related to our national agricultural development and her fish are part of our national food supply. This means, on the one hand, that the Territory is entitled to receive the benefits of Federal appropriations and the services of Federal organizations designed to further the public welfare of the whole country, and, on the other hand, that the same national policies should be applied in Alaska as elsewhere. There is no more reason why a separate and different system should be set up for dealing with the public forests of Alaska than there is for setting up such a system in each State. Alaska needs the application to her forest problems of the experience, technical knowledge, and organization provided by the Forest Service; while the policy followed should be at one with that of the entire country, of which Alaska is simply a part.

THE PERSONNEL OF THE FOREST SERVICE.

The diversified and widely distributed work of the Forest Service and the large proportion of its employees in whom specialized training, initiative, and ability to accept responsibility are essential qualifications make the aggregate efficiency of its personnel a matter of the utmost concern. No problem outweighs in importance that of preventing retrogression or stagnation in the quality of service rendered to the Government and the public. The most critical difficulty which confronts the Forest Service to-day is that of securing and holding a personnel able in numbers and in qualifica-

tions to do efficiently the growing volume of work which we are called upon to perform.

The most immediate need is to increase the short-term protective force on the National Forests. Destructive forest fires occur because the number of guards and patrolmen which can be employed is inadequate to cover the areas needing protection. The average field officer in the four worst fire districts attempts to protect 52,000 acres. Experience demonstrates that in a normal season this protective organization is sooner or later strained beyond the breaking point, leading to serious losses of public property and emergency expenditures much greater than the cost of an organization sufficient to prevent forest fires from starting. An increase in the protective force is dictated by public economy from every standpoint.

The second outstanding need of the Forest Service is to build up its technical personnel, still depleted from the effects of wartime and subsequent conditions. For a period of four years the Service has suffered a steady loss of trained and experienced men. The rebuilding of its technical force has been blocked to a large degree by the necessity of employing every dollar on fire protection that could be made available by the large increases in wages necessarily paid to temporary employees, and by corresponding increases in the cost of equipment, supplies, and transportation. The number of technically trained forest examiners and forest assistants has dwindled from 229 in 1914 to less than 150 at the present time. The effects of this loss are painfully felt in the shortage of seasoned and qualified men to fill responsible positions in the administrative organization of the Service and to handle specialized work in its expanding activities. The force of grazing examiners and grazing assistants also falls far short of meeting the urgent needs arising in the efficient administration and improvement of the National Forest ranges.

For lack of technically trained men of adequate experience the Forest Service is now but poorly equipped to meet the growing volume of timber use on the National Forests, the imperative need of more intensive administration of range lands, and the expanding requirements of research work and cooperation with the States in fire prevention. But the worst feature of this situation is its menace for the future. There is no other training school in which men can be prepared for postions of responsibility and leadership in the Forest Service so well as in the Service itself. If the Service can not be steadily recruited in the lower ranks by able and well-trained young men, it will certainly in time begin to die at the top, and its capacity to serve the public will steadily decline. This danger is even more serious in the light of the steady growth in the use of the National Forests and in the responsibilities which the Forest Service is required to assume in relation to the entire problem of national timber supply.

The present requirements in this respect, which scarcely can be presented too strongly, are for an additional number of grazing and forest assistants who can be thrown directly into the technical administration of National Forest timber and range lands. The section of this report dealing with forest management indicates the extent

of the demand for National Forest timber now coming about in connection with the depletion of eastern forest regions and the character of technical work necessary to supply these legitimate needs while keeping up the productivity of the public timber holdings and insuring a steady supply of commercial products from them in the future. The section of the report dealing with range management brings out the importance of a similar technical and constructive development in the use of the forage crops on the National Forests. Neither of these important functions can be discharged effectively without a steady inflow of trained personnel adequate to the scope and volume of the work to be done.

As part of the same problem, I must again urge, as in the report of the preceding year, the need for relief from conditions which cause a constant drain from the organization of its experienced and efficient men, with inevitable retrogression in the efficiency of our service to the hundreds of thousands of people and the many industries which use the National Forests. The annual turnover in the various groups of scientific and technical employees still ranges from 14 to 27 per cent. The outside compensation received by these former employees of technical training exceeds, on the average, their total compensation in the Government service by 60 per cent. During the fiscal year 1920, 330 rangers, a full third of the ranger force, resigned. The Forest Service is compelled to function in no small measure as a training school for private business enterprises, taking green and inexperienced employees from the civil-service register, carrying them through a breaking-in period which is comparatively unproductive, and then losing a large proporation of them at the time when they are qualified for really effective work.

The personnel of the Forest Service will never be placed on a sound basis for making good to the Government and the public in the work expected of it until two changes are accomplished. The first is a general reclassification of grades and positions, with reasonable increases in rates of compensation and reasonable opportunities for advancement as experience and other qualifications justify. This step, of course, waits upon general legislation affecting all departments. The second step requires only a change in the form of certain appropriation items which will do away with the evils of a fixed statutory roll prescribed for classes of employees who do not belong on such a roll.

Forest supervisors, deputy forest supervisors, and forest rangers are now carried partly on a statutory roll and partly under lump-fund items. This division is illogical and discriminatory. The work of these groups of men is executive, requiring the supervision of field employees, the direction of business transactions on National Forests, and constant and responsible relations with the general public. To a large degree, it is also technical and specialized, involving the application of forestry and grazing management in the use and development of National Forest resources. The general policy of the Government has recognized the need for carrying employees of such duties and qualifications on lump-sum rolls. Thereby only can the differences developing in the efficiency of individuals, in the responsibility of their positions, and in the living costs and other factors which should be recognized in their compensation be equitably ad-

justed. The fixed statutory roll renders it impossible to recognize these differences and is primarily responsible for the excessive turnover in these grades. Furthermore, adjustments in National Forest units and in the duties and responsibilities of individual field officers are frequently possible in the interest of economy or efficiency; but such adjustments are seriously handicapped without opportunity to adjust rates of compensation to fit the new conditions or duties.

A similar situation obtains in the case of the administrative assistants on National Forests. These employees must handle routine correspondence, accounts, office records and reports, many business transactions with Forest users, the shipping and receiving of freight and supplies, the custody of public property, the hiring and dispatching of fire-fighting crews, and purchases of supplies and materials. Their positions are rated as clerical, but the job calls for an all-around business assistant. Even before the war it was impossible to obtain competent men for many of these places. In the fiscal year 1920 the Service lost 44 per cent of the employees in this capacity. During the past year the loss was 31 per cent.

By changes from statutory to lump-sum items, without increasing the amounts appropriated, this serious weakness in the National Forest personnel can in time be largely corrected. Such changes will permit holding more competent employees and adjusting duties from time to time so as to secure economy and efficiency in the handling of National Forest work which is not now possible.

NATIONAL FOREST RECEIPTS AND EXPENDITURES.

The income-producing business of the National Forests during the fiscal year 1921 resulted in receipts paid in or still due of $4,468,940. Of this amount, $1,964,005 due for grazing privileges had not been paid by July 1, 1921, pursuant to the special legislation for this year, which authorized the postponement of grazing fees until December 1 next.

As compared with the fiscal year 1920, the receipts show a decrease of $324,542, or 6.7 per cent. The grazing receipts, assuming that all outstanding obligations are paid in full, will show a falling off from 1920 of less than one-half of 1 per cent. The receipts from timber sales decreased $291,494, or 14.1 per cent. In view of the general business depression during the 12 months prior to July 1, 1921, the relatively small decrease in revenue illustrates the marked, indeed, the extraordinary, stability of the business supported by the National Forests. This fact is brought out in greater detail later in the report.

Legislation has been recommended which will authorize the crediting of deferred grazing fees, due under permits issued during the fiscal year 1921, to the receipts of that year. This is for the purpose of accomplishing the normal apportionment of the 25 per cent of gross receipts payable to the States for road and school purposes, and of the additional 10 per cent expendable by the Secretary of Agriculture on roads within the National Forests. This action is necessary to avoid serious inconvenience and possible hardship to many western counties to which the receipts from National Forests are an important source of income, and to avoid an interruption in

the construction and maintenance of National Forest roads in pursuance of the authorized appropriation for this purpose.

The following table shows the purposes for which the total appropriation for the Forest Service carried by the agricultural appropriation act was expended. The items do not include deficiency appropriations, or the appropriation for the fire protection of forested watersheds of navigable streams against fire, in cooperation with States.

Expenditure of Forest Service appropriations.

Protection and administration of the National Forests [1]		$4,943,642
Fighting fires which could not be suppressed by regular protective force [2]		250,000
Classification, survey, and segregation of agricultural land, and accomplishment of authorized land exchanges		87,000
Planting of 5,505 acres of nonproducing land, maintenance of nurseries, and experiments in tree planting		120,640
Permanent improvements, such as buildings, bridges, trails, telephone lines, drift fences, and water improvements [3]		400,000
Estimating the amount and fixing the minimum value of timber for sale		50,000
Examination of intensively used ranges with a view of increasing their productivity by more scientific management of stock and forage		30,000
Investigations:		
Forest products, including Forest Products Laboratory at Madison, Wis.	$223,260	
Silvicultural	50,000	
Range and forage plant	35,000	
		308,260
Recording, digesting, and disseminating the results of scientific technical work		31,280
Total		6,220,822

The total expenditures exceeded those during the preceding fiscal year by $378,953, or 6.3 per cent. The increase in the expenditures for administration and protection of the National Forests, including fire suppression, was $402,952, or more than the total increase in the amounts appropriated. In other words, other activities had to be cut down to provide for essential needs in the protection of the Forests and their use by the public.

NATIONAL FOREST PROPERTIES.

The net area of the National Forests at the close of the fiscal year was 156,666,045 acres, as against 156,032,053 acres one year before. The corresponding gross areas were 181,820,459 acres and 180,299,776 acres. The gross area includes all land within the National Forest boundaries; the net area excludes alienated lands.

The net increase of 633,992 acres includes 193,637 acres acquired by purchase under the act of March 1, 1911, and 321,360 acres in northern California added by Congress to the Modoc National Forest. Special acts of Congress authorized small additions to five other

[1] An additional emergency appropriation of $100,000 was made available for the protection of the "blow-down" area on the Olympic National Forest, Wash. (see p. 13), of which approximately $50,000 was expended before the fiscal year closed.

[2] An additional deficiency appropriation of $775,000 was required for this purpose.

[3] Of this sum nearly half is required for the maintenance of existing improvements used in the protection and administration of the National Forests.

National Forests, while by proclamation of the President small areas were added to four Forests in Arkansas, Arizona, Florida, and New Mexico. Selection by the States of other public lands outside of the National Forests caused title to many school sections to revert to the Government during the year. Nineteen presidential proclamations and Executive orders eliminating from individual National Forests 82,574 acres and an elimination of 9,498 acres due to land exchange with the State of South Dakota partially offset the increases.

The 19 minor eliminations represented the final adjustment of boundaries following the practical completion of land classification. Few exclusions from the National Forests can hereafter be made. except to the detriment of these important public properties. Changes in Forest boundaries must hereafter be in the nature of extensions which embrace all of the true forest land within a natural unit of forest production. At the close of the fiscal year 15 bills contemplating additions to National Forests were pending before the public lands committees of the Sixty-seventh Congress.

The approval by the National Forest Reservation Commission of the Alleghany Purchase Area, comprising approximately 1,000,000 acres in McKean, Forest, Elk, Warren, and Potter Counties, Pa., on the North Fork of the Alleghany River, and the extension of purchases to the Alabama, Arkansas, and Ozark National Forests have increased the total area within which purchases are authorized under the Weeks law to approximately 9,225,000 acres. Of this total, 2,535,926 acres are now in Government ownership. The holdings are being increased through purchases as rapidly as the funds available permit. At the close of the year the total of purchased lands reached 1,613,845 acres, while an additional 265,434 acres had been approved for purchase by the National Forest Reservation Commission.

Outside of the present eastern National Forests many other areas of rugged, broken, forested country are equally important in their relation to the maintenace of navigable streams and equally valuable as sources of forest production. Conspicuous among such areas are the Berkshire Hills of Massachusetts and Connecticut; the Kentucky River and Cumberland watersheds in Kentucky; the Current River region and St. Francis Mountains in Missouri; the Brown County section of Indiana; the Piedmont Plateau of Virginia, North Carolina, and South Carolina; and other areas in Texas, Oklahoma, Michigan, Wisconsin, Alabama, West Virginia, Mississippi, and Maryland. A reconnaissance to determine the need for an extension of purchase work to lands not now included within authorized areas was approved by the National Forest Reservation Commission just prior to the close of the year.

The three specific things the Government should endeavor to accomplish in its program of forest purchases are:

(1) To complete the acquisition of areas having an important relation to the control of erosion and regulation of navigable streams.

(2) To acquire for the future national supply of forest products timber-growing lands, chiefly denuded or cut over, which are located in the forest regions having the greatest importance from geographic location and productive possibilities. These should include a large proportion of lands whose reforestation will be difficult and ex-

pensive which therefore should be a public rather than a private obligation.

(3) To establish in the major forest regions now lacking them National Forests which will serve as demonstration areas of forestry practice. The attainment of these ends requires the removal of the present limitation upon purchases to areas within watersheds of navigable streams, in recognition of a national obligation to aid in the production of timber on forest lands generally.

This enlarged program would involve (1) the acquisition of approximately 3,000,000 acres on important watersheds in the Eastern States, within acquisition areas previously established by the commission and such new areas as may be found desirable, at an average cost not exceeding $8.50 per acre, and (2) the acquisition of approximately 7,000,000 acres without special reference to the watersheds of navigable streams, but comprising chiefly lands which will not be reforested except under public ownership. The average cost of such areas would probably be within $3.50 per acre. The total cost of such a program, which would require from five to ten years for accomplishment, would be $50,000,000.

The importance and necessity of general legislation whereby the completion and adequate protection of the National Forests may be secured through consolidation by exchanges with private owners has been emphasized in an increasing degree by the developments of the past fiscal year. Aggregating 25,154,414 acres and amounting to almost one-seventh of the total gross area of the National Forests, these private lands constitute a growing problem both to the Government and to their owners. Located largely by the chance of grants in place, and rarely valuable for any purpose except forest production or associated uses, these lands lie interspersed among those under Government control and by their very location often jeopardize and hamper the effective management of the Government's holdings. Scattered as they are, the harvesting of the forest or forage products of the private lands involves heavy costs that would be unnecessary were the lands located in compact bodies. The value of the intermingled Government lands for like purposes is correspondingly diminished. The situation exists in some degree on almost every National Forest and can be met only by laws of general application.

At the close of the fiscal year 24 separate bills authorizing exchanges or consolidations were pending before the Committees on Public Lands of the Sixty-seventh Congress. The valuable results which will follow the enactment of these measures can not be disregarded, but they represent the piecemeal solution of a pressing problem which could better be worked out by general legislation. The process of consolidation by exchange will at best require many years of careful study and negotiation. Exclusive of exchanges with the several States, the number of exchanges with owners of private lands consummated during the past 10 years under authority of the several acts passed by Congress during that period has been 43, the land surrendered amounting to 141,522 acres and the land granted in lieu thereof to 101,665 acres. Values in each exchange have been carefully balanced with due regard to the Government's interests. The results demonstrate that exchanges afford means of materially enhancing the value of the Nation's forest properties, and legislation

permitting a more general and rapid adjustment of the matter is vitally necessary.

PROTECTION.

PROTECTION OF THE NATIONAL FORESTS.

The number, classes, and causes of the fires on the National Forests in the calendar year 1920, compared with those in the previous year, are as follows:

Comparison of fires on National Forests, calendar years 1919 and 1920.[1]

Classes and causes of fires.	Number of fires.		Percentage of total.	
	1919	1920	1919	1920
Class of fire:				
Burns less than 0.25 acre	2,839	3,122	41.75	51.37
Burns between 0.25 acre and 10 acres	2,014	1,724	29.62	28.36
Burns 10 acres and over, damage under $100	1,170	884	17.21	14.54
Burns 10 acres and over, damage $100 to $1,000	449	249	6.60	4.10
Burns 10 acres and over, damage over $1,000	328	99	4.82	1.63
Total	6,800	6,078	100.00	100.00
Causes of fires:				
Railroads	701	508	10.31	8.36
Lightning	2,197	3,081	32.31	50.69
Incendiarism	339	245	4.99	4.03
Brush burning	360	248	5.29	4.08
Campers	1,466	1,053	21.56	17.33
Lumbering	278	211	4.09	3.47
Unknown	1,155	485	16.98	7.98
Miscellaneous	304	247	4.47	4.06
Total	6,800	6,078	100.00	100.00

[1] Statistical records of fires, to have significance, must deal with complete seasons, and therefore cover calendar years.

The area of National Forest lands burned over was 342,193 acres, as against 2,007,034 in 1919; the estimated damage was $419,897, as against $4,919,769; and the total cost of fire fighting (exclusive of the time of Forest officers) was close to $1,000,000, as against $3,039,615. District 1 (Montana and northern Idaho) had much the largest number of fires (1,716), and had 25 of the 99 fires which caused damage in excess of $1,000. District 6 (Washington and Oregon) had 1,385 fires, and district 5 (California) 1,338. Together, these three districts had 73 per cent of all the fires—exactly the same percentage as in 1919.

The figures given above reveal some instructive contrasts. While the total number of fires decreased 10.6 per cent, the number of lightning-caused fires increased 40.2 per cent. The decrease in man-caused fires was very marked, with a drop of 35 per cent. The number of campers' fires decreased 28.2 per cent, and this in spite of the fact that recreational use of the Forests is growing by leaps and bounds.

Again, not quite nine-tenths as many fires were fought, at about one-third the cost; they covered one-sixth the area, and did one-twelfth the damage. The number of fires which burned less than one-fourth of an acre was considerably greater than in 1919, while

less than one-third as many covered 10 acres and did over $1,000 damage.

Any attempt at interpreting these data must take into account the great differences in the character of the two seasons. The general character and history of the 1920 season were summarized in last year's report. In contrast with the season of 1919, which both in length and severity was one of the worst that the West has ever known, it was short, but acute while it lasted. An unprecedented number of fires were caused by lightning, exceeding by 25 per cent the highest previous record.

Lightning fires are apt to be particularly hard to control, for two reasons: They occur most commonly in the high mountains, where they are hard to get at quickly, and they often occur in considerable numbers almost simultaneously, so that the protective force is taxed to the utmost to meet the strain without cracking. On one Forest in California—the Klamath—a series of storms started 48 fires within six days, while on the Trinity a single disturbance in one day started 70, besides causing a number of others on neighboring Forests. Under such conditions, to bring all the fires under control before they reach large dimensions is beyond human capacity with the present protective force and equipment. In district 6 (Oregon and Washington) practically all the fires requiring heavy expenditures to bring under control were lightning-caused.

The peak of the load occurred in district 1 (Montana and northern Idaho). Topography, climate, and wilderness conditions combine to make the problem of fire prevention in portions of western Montana and northern Idaho well-nigh insuperable at the present time. In this district, almost always characterized by extreme summer drought, the precipitation for June, July, and August was about two-thirds of normal. During the season there were 1,281 lightning fires—75 per cent of the total from all causes. And over 30 per cent of all the fires broke out within a single 10-day period.

A large outlay for fire fighting was inevitable under such conditions. Since the appropriation for fire fighting was only $250,000, deficiency appropriations became necessary to replenish the general administration funds. Two such appropriations were made by Congress, totaling $775,000. Fortunately, an exceptionally favorable spring and early summer, with late rains, resulted in expenditures in the latter part of the fiscal year far below what is normally required, so that at its close there remained an unexpended balance of $50,000.

The 1921 season has continued, on the whole, favorable to the date of this report, and the expenditures for fire fighting have been decidedly below what must be looked for in years of normal hazard. Nevertheless, the fire-fighting fund for the fiscal year of $250,000 has been exhausted and additional liabilities of approximately $225,000 incurred. The greater part of the expenditures have been in Montana, Idaho, and California.

A hazard of unique character was created by the tremendous blow down of timber on the west side of the Olympic Peninsula, in Washington. Something like 6,000,000,000 feet of timber are estimated to be on the ground, creating the most formidable fire trap the Forest Service has ever had to reckon with. The bulk of the down timber is outside the Olympic National Forest, but if fire

were once to get underway in this almost impenetrable mass of huge fallen trees its control would be practically impossible, and large losses would undoubtedly be suffered by the National Forest. To meet this situation the Forest Service, under authority of a special deficiency item, has cooperated with the State authorities and private owners in maintaining the most intensive protection ever attempted in the United States. This is mainly a matter of organizing the entire local public to eliminate all human causes of fire. It is something of a triumph to have come through the first and probably most dangerous season successfully.

During the past 11 years, 42,000 "man-caused" fires have started in the National Forests. These are more than two-thirds of all the fires with which the Forest Service has had to contend. In organizing for more and more efficient protection, it would be the height of folly to overlook the principal source of fire hazard, which lies in human ignorance or indifference.

The use of the National Forests for industrial and recreational purposes is rapidly increasing. Thousands of people now traverse or camp in the National Forests where there were but scores or hundreds six years ago. The annual number of man-caused fires is a barometer of the hazard occasioned by this enormous increase in the use of the Forests, a barometer which must be watched with the utmost care. If the number of man-caused fires increases proportionately with the use of the Forests, the task of protecting them is well-nigh hopeless. From 1914 to 1917 there were from 4,300 to over 5,600 man-caused fires each year. Since 1917, while varying to a considerable degree, on account of climatic conditions, the movement has been downward. Last year approximately 3,000 fires were of human origin. While caution is necessary in drawing conclusions, it is probable that this result is due in part to the efforts of the Service in common with those of States and many private agencies to educate the public on the necessity for care with fire in the woods, to the increasing cooperation furnished by the press and by many commercial and semipublic agencies, and to a campaign of strict law enforcement against offenders.

There is no more important phase of fire protection than that of inculcating by every possible means the necessity for care in the use of fire on the part of every citizen and every industrial enterprise which uses or traverses the public forests. The forest fire evil, with its long train of costly destruction and emergency expenditure, can only be eradicated by public education. The proclamation of a "Forest Protection Week" by the President of the United States and by the governors of many States and the wide observance of this week, brought about through organized publicity and other educational efforts dealing with forest fires, were unquestionably of immense value.

Aside from attacking man-caused fires at the source, years of experience have only emphasized the truism that effectiveness in protecting forests is measured by the speed with which fires can be discovered and reached. The efforts of the Forest Service are concentrated on rounding up all the big and little means of securing

prompt discovery of incipient fires and quick action in reaching them. The main reliance for prompt discovery must be a lookout service, well distributed over peaks and other effective points and continuous during the daylight hours. The second essential is a network of telephone lines, inexpensively constructed by attachment to trees, so that the lookout can instantly communicate the alarm to the ranger, patrolman, or guard who is nearest the telltale column of smoke. About 3,000 fires are thus put out on the National Forests every year before they reach a quarter of an acre in size. But fires may be fanned by heavy winds or may run in inflammable slashings or may be so inaccessible that they can not be reached quickly enough to be extinguished single handed, particularly if many fires are started simultaneously by a lightning storm or by a defective locomotive on an upgrade. Quick action must then be possible in mobilizing the available rangers and guards, in equipping them with fire-fighting tools and supplies of food, and in drawing upon local settlers, miners, stockmen, and the crews of lumber camps for fire fighters. Such situations frequently occur and necessitate a warehouse and supply service whereby standardized equipment and foodstuffs can be furnished promptly in the quantities needed and an organization put quickly into action which extends from the base of supplies to the fire line, not unlike the organization needed for a military offensive.

Success in suppressing large fires in National Forests depends upon the completeness and perfection of this organization and its training in advance for dealing with every fire in every stage, with the utmost speed and without confusion or indecision. To bring its fire organization up to or near this ideal is the most important task of the Forest Service. It involves knowledge of technical appliances and methods and effective use of the crystallized experience gained in many years. Above all, it requires trained men who know the game. One of the outstanding needs of the Forest Service at the present juncture is to provide, even on a limited scale, for the systematic training of its field officers in the technique of fire control and suppression.

In recognition of the primary importance of an efficient fire organization, every possible effort has been made to increase the force of guards during the present fire season, at the cost of drastic cuts in other lines of work. With the appropriations made for the fiscal year 1922 it has been possible to add 68 men to the fire force in the four worst fire districts. The average forest ranger and guard in these districts, however, must still cover 52,000 acres. Experience has clearly demonstrated that this force is inadequate. Even during the average season, disregarding exceptional climatic hazards of frequent occurrence, it is not possible for the existing organization to reach and put out promptly a considerable number of fires which thereupon become large blazes and require heavy emergency expenditures. The loss in public property and in public funds from such emergencies, because the authorized force was too small to reach the fires in time, still continues. It will again be necessary to request Congress for a deficiency appropriation, because the fire-fighting resources provided in the regular budget were not adequate.

From the standpoint of appropriations, the outstanding need of the Forest Service in its business of protecting public property is to increase the summer guard force so that at least a larger proportion of the fires can be reached and extinguished when small and the necessity for emergency expenditures correspondingly reduced.

INSECT INFESTATIONS IN SOUTHERN OREGON AND NORTHERN CALIFORNIA.

A very serious infestation of tree-killing insects has been brought forcibly to public attention during the past year. One and a quarter million acres in southern Oregon and northern California, one of the finest bodies of pine timber remaining in the United States, are infested to a greater or less extent with bark beetles. The damage to date is estimated at $3,000,000. Efforts have been made by a few private owners to eradicate the insects, but isolated attempts are unavailing in the midst of such an enormous area of infested timber. Of the forest area actually infested or menaced, approximately 250,000 acres are in the Klamath Indian Reservation, 100,000 acres in the revested Oregon and California land grant, 25,000 acres in the public domain, and 285,000 acres in National Forests. The remaining half of the total area is privately owned. An estimated stand of 10,000,000,000 feet of timber, valued at $30,000,000, is threatened with destruction.

The State of Oregon has enacted effective laws for compelling the cooperation of private forest owners in ridding their timber of insects; but State and individual efforts will be futile unless the Government joins forces in wiping out the pest. The intermingled public and private timber must be cleared of beetles at the same time; otherwise no area will be safe from reinfestation. An estimate has therefore been submitted to Congress for a deficiency item of $150,000, which will pay the cost of protective work on the Government's lands.

COOPERATION WITH STATES IN FOREST PROTECTION.

Expenditures from the appropriation of $125,000 made by Congress for fire protection on the forested watersheds of navigable streams in cooperation with the States, and the expenditures of the States which have entered into cooperative agreements for this purpose, are shown in the following table. The lands protected are in State or private ownership.

Cooperative expenditures, fiscal year 1921.

State.	Federal.	State.	Total.
Maine	$5,597.50	$136,520.42	$142,117.92
New Hampshire	6,795.17	37,003.70	43,798.87
Vermont	2,737.20	7,721.49	10,461.69
Massachusetts	3,137.00	51,297.95	54,434.95
Rhode Island	501.00	3,896.22	4,397.22
Connecticut	1,349.92	6,270.09	7,620.01
New York	7,678.61	183,577.47	191,256.08
New Jersey	2,703.37	30,643.40	33,346.77
Pennsylvania	9,079.81	108,196.70	117,276.51
Maryland	2,255.36	5,013.47	7,268.83
Virginia	5,8 2.50	11,533.88	17,386.38
West Virginia	5,603.50	7,150.49	12,753.99
North Carolina	2,226.00	5,052.77	7,278.77
Louisiana	1,634.50	11,465.25	13,100.75
Texas	3,751.02	4,309.42	8,060.44
Michigan	7,240.00	90,344.38	97,584.38
Wisconsin	2,904.25	14,569.86	17,474.11

Cooperative expenditures, fiscal year 1921—Continued.

State.	Federal.	State.	Total.
Minnesota	$10,272.00	$150,665.53	$160,937.53
South Dakota	100.00	7,734.20	7,834.20
Montana	3,019.90	4,530.62	7,550.52
Idaho	3,681.36	87,078.77	90,760.13
Washington	7,499.00	46,810.59	54,309.59
Oregon	7,494.00	32,617.69	40,111.69
California	5,312.00	22,030.46	27,342.46
Administration and inspection	11,098.11	.....	11,098.11
Total	119,523.08	1,066,038.82	1,185,561.90
Unexpended balance	5,476.92		
Appropriation	125,000.00		

Cooperation in fire protection was continued with 24 States on the same basis as in recent years. A $25,000 increase in the appropriation permitted urgent increases in the allotments to certain States. No new States qualified in time to receive allotments during the year, but Ohio, Tennessee, and New Mexico, enacted legislation under which cooperation can be extended next season. Kentucky, which it was hoped might resume the cooperation suspended somewhat over a year ago, has dropped out, owing to legislation which has completely crippled the State forestry work.

The year 1920 was the fifth consecutively for which statistics were obtained, in cooperation with State and private agencies, on forest fires in all parts of the United States so far as records are obtainable. During this period it is estimated that the number of fires averaged 32,517 annually, the area of forest land burned 7,560,000 acres, and the immediate property loss $17,240,000. It is this condition, more than any other factor, which has caused the depletion of the timber supply of the United States. Seventy-nine per cent of the forest lands in the country, aggregating 369,000,000 acres, is in private ownership. Approximately 219,000,000 acres out of this total are wholly unprotected from fire, and on many other areas the protection is incomplete and inadequate. It is primarily because such a large proportion of our young forest growth has been burned up that the country is now taking out of its forests every year over four times the quantity of timber which is being grown. Already some 81,000,000 acres of forest-growing land have been so denuded as to become practically idle. On other enormous areas of cut-over land, the second growth forest is sparse and incomplete because of recurring fires.

Cooperation with the States in fire prevention, with reference primarily to the protection of navigable watersheds and in pursuance of the act of March 1, 1911, for the conservation of navigable waters, represents the first systematic and comprehensive step taken by the Federal Government toward checking this loss on the privately owned timberlands of the United States. In the decade following this step, the protection of private forest lands has been built up from almost nothing to a point where about one-third of the resource can be said to be adequately protected. In large measures as the result of Federal leadership and encouragement, the current expenditures for forest protection on the part of States and private owners are seven times the Federal appropriation for this purpose.

The extension of organized forest protection under this plan, with the Federal Government taking the lead as a standardizing and cooperating agency, is one of the most essential steps in our forestry policy. It should, as rapidly as possible, include all of the 39 States which contain important forest resources. Experience has demonstrated that the technical leadership and financial cooperation of Federal agencies are factors of the highest importance in initiating local protective organizations and in stimulating the expenditures of State and private funds for this purpose.

NATIONAL FOREST MANAGEMENT.

TIMBER.

The general business depression affected, of course, the lumber industry. Prices at the mill were in some cases less than half those received for the same grades a year previously. Many mills shut down and many more operated only part time. Yet the cut of National Forest timber increased 3½ per cent, and was larger than in any previous year. While the rate of cutting slackened noticeably toward the end of the year, the new sales exceeded in value and nearly equaled in amount those of the fiscal year 1920.

The decrease of 14.1 per cent in the receipts from timber sales, mentioned on page 8, in the face of an increased cut, needs explanation. Advance payments are required on timber sold. The drop in receipts was due partly to the slackening of operations late in the year, partly to disinclination of operators to tie up any larger sums in advance payments than was absolutely necessary. In short, at the close of the year considerably less money was in bond for timber still to be cut than was the case a year previously.

Both the cut and the sales (largely of timber for future cutting) show strikingly the stability of the National Forest timber business. This stability is an outcome of a sales policy which definitely aims at providing first for local needs and at making the Forests contribute to the support of permanent industries and stable communities. The policy aims also at encouraging the development of new enterprises of a kind and on a scale to utilize most effectively the raw material which the Forests can best produce, on a sustained-yield basis. On the White Mountain National Forest, in New Hampshire, for example, the timber management plans contemplate provision for the needs of permanent establishments for manufacturing boxes, bobbins, spools, toys, and other novelties, as well as for permanent pulp and lumbering industries. The local value of such enterprises, supporting wage earners, putting money in circulation, indirectly furnishing a home market for agricultural products, and thus contributing to the highest economic life of the region, is obvious.

On this Forest an allowable output of timber from each major watershed approximately equal to the annual growth has been determined. Cutting will be limited to this amount. At a result, local industries can count with confidence on permanent supplies of raw material, in contrast to the usual history of industries based on timber in private ownership, with operations conducted on a large scale for a few years, followed by exhaustion of the timber and migration to fresh fields.

Similar plans are being pushed for the National Forests in the southern Appalachians and Arkansas. It is of special importance that local farmers have opportunity for winter employment in getting out logs or other Forest products from the near-by National Forests when work on the farm is slack. Already many new permanent manufacturing industries have been established or transportation facilities installed as a direct result of the Forest Service timber management policy. It is being applied on all National Forests, including those of Alaska, where it is the intention to provide for permanency for the pulp and paper industry instead of a mushroom growth followed by exhaustion and local economic disaster.

A sale pending at the close of the year, and made since, on the Washakie Forest in Wyoming, covered an estimated quantity of 1,062,000 railroad ties, equivalent to about 40,000,000 board feet, and about 20,000,000 board feet of saw logs, which the purchaser may, if he desires, take for the production of sawed ties. He can also cut large amounts of mine props from the tops of the trees cut for ties. These products will be used locally, the ties by a railroad and the mine props in local coal mines. The hewn ties alone, at 5 cents each, will bring $53,000 into the Treasury during the five years allowed for cutting and removing the timber. For eight years the purchaser has been operating on adjacent areas of National Forest timber, cutting chiefly ties, which are driven down streams too small to float saw logs and then 125 miles down a river to the railroad.

A sale in California will not only supply both local and general market needs for boxes and lumber, but will also aid greatly in the development of the locality. This sale is for about 600,000,000 board feet located in the Sierra Forest. The successful bidder has about 700,000,000 board feet on privately owned land adjoining and intermingled with the Government timber. He has agreed to build nearly 50 miles of main-line railroad, which will be a common carrier, and which, therefore, will serve all owners of property in a locality previously without good transportation facilities. On account of the intermingling of the private and Government lands and the large combined timber volume, a period of 30 years is allowed for cutting and removal, but the initial prices, $4.25 per thousand board feet for sugar pine, $3 for western yellow pine, and $1.50 for other species, are to be readjusted in 1926 and at three-year intervals thereafter.

A sale of 84,000,000 feet of timber, chiefly western yellow pine, on the Crater National Forest in Oregon, will result in the resumption of operation on a short local railroad and bring a new lumber-producing industry into the locality. The lumber will be sold chiefly in the general market. Nine years are allowed for cutting and removal, of which the first two will be needed for the construction of improvements. The initial prices of $3.75 per thousand board feet for pine and 75 cents per thousand for other species are subject to readjustment in 1925 and 1928, but even at the initial rates the total value of the timber is $315,000.

In all sales, the future productiveness of the ground is assured by the retention of young, thrifty trees or of seed trees, and by

precautions against fire, including the disposal of the inflammable slash.

Timber sold fiscal year ended June 30, 1921.

State.	Board feet.			Value.		
	Commercial sales.	Cost sales.	Total.	Commercial sales.	Cost sales.	Total.
Alabama	15,000	.....	15,000	$29	.....	$29
Alaska	144,895,000	.....	144,895,000	154,422	.....	154,422
Arizona	12,674,000	647,000	13,321,000	33,968	$544	34,512
Arkansas	6,126,000	236,000	6,362,000	35,783	208	35,991
California	359,286,000	2,002,000	361,288,000	1,230,927	1,135	1,232,062
Colorado	18,714,000	1,484,000	20,198,000	48,769	1,125	49,894
Florida	2,014,000	.....	2,014,000	7,715	.....	7,715
Georgia	1,078,000	.....	1,078,000	5,404	.....	5,404
Idaho	164,950,000	3,659,000	168,609,000	620,408	2,772	623,180
Michigan	32,000	12,000	44,000	140	9	149
Minnesota	2,775,000	.....	2,775,000	12,885	.....	12,885
Montana	192,850,000	5,520,000	198,370,000	505,512	4,489	510,001
Nevada	1,273,000	57,000	1,330,000	1,427	41	1,468
New Hampshire	2,655,000	.....	2,655,000	18,746	.....	18,746
New Mexico	13,566,000	1,667,000	15,233,000	39,145	1,092	40,237
North Carolina	1,532,000	.....	1,532,000	3,932	.....	3,932
Oregon	87,127,000	3,080,000	90,207,000	182,548	1,880	184,428
South Dakota	7,107,000	871,000	7,978,000	18,293	747	19,040
Tennessee	2,592,000	188,000	2,780,000	3,459	165	3,624
Utah	17,484,000	1,161,000	18,645,000	59,661	910	60,571
Virginia	5,964,000	39,000	6,003,000	24,188	32	24,220
Washington	88,519,000	657,000	89,176,000	150,037	363	150,400
West Virginia	665,000	.....	665,000	2,919	.....	2,919
Wyoming	14,337,000	676,000	15,013,000	34,850	539	35,389
Total, 1921	1,148,230,000	21,956,000	1,170,186,000	3,195,167	16,051	[1] 3,211,218
Total, 1920	1,294,446,000	32,476,000	1,326,922,000	3,026,186	21,559	[2] 3,047,745

[1] In addition, minor products, not convertible into board feet, were sold; value, $4,004.
[2] In addition, minor products, not convertible into board feet, were sold; value, $25,815.

Timber cut under sales, fiscal year ended June 30, 1921.

State.	Board feet.			Value.		
	Commercial sales.	Cost sales.	Total.	Commercial sales.	Cost sales.	Total.
Alabama	15,000	.....	15,000	$29	.....	$29
Alaska	36,881,000	.....	36,881,000	62,480	.....	62,480
Arizona	45,705,000	613,000	46,318,000	107,683	$527	108,210
Arkansas	13,748,000	243,000	13,991,000	56,239	205	56,444
California	139,318,000	2,591,000	141,909,000	352,416	1,338	353,754
Colorado	44,208,000	1,341,000	45,549,000	108,852	1,014	109,866
Florida	1,515,000	.....	1,515,000	4,735	.....	4,735
Georgia	2,850,000	.....	2,850,000	12,808	.....	12,808
Idaho	121,406,000	4,116,000	125,522,000	334,622	3,163	337,785
Michigan	1,167,000	8,000	1,175,000	1,954	6	1,960
Minnesota	9,328,000	200,000	9,528,000	29,690	100	29,790
Montana	56,665,000	6,820,000	63,485,000	125,940	5,513	131,453
Nevada	1,207,000	25,000	1,232,000	1,600	17	1,617
New Hampshire	3,785,000	.....	3,785,000	21,436	.....	21,436
New Mexico	22,999,000	1,717,000	24,716,000	47,907	1,001	48,908
North Carolina	9,998,000	.....	9,998,000	28,527	.....	28,527
Oregon	126,098,000	4,214,000	130,312,000	262,527	2,429	264,956
South Dakota	21,880,000	589,000	22,469,000	59,102	484	59,586
Tennessee	7,583,000	196,000	7,779,000	9,927	160	10,087
Utah	10,477,000	891,000	11,368,000	27,044	705	27,749
Virginia	4,777,000	43,000	4,820,000	15,079	35	15,114
Washington	88,333,000	628,000	88,961,000	160,347	343	160,690
West Virginia	441,000	.....	441,000	1,986	.....	1,986
Wyoming	37,862,000	783,000	38,645,000	92,815	605	93,420
Total, 1921	808,246,000	25,018,000	833,264,000	1,925,745	17,645	[1] 1,943,390
Total, 1920	783,947,000	22,184,000	806,131,000	1,754,599	15,800	[2] 1,770,399

[1] In addition, minor products, not convertible into board feet, were cut; value, $3,488.
[2] In addition, minor products, not convertible into board feet, were cut; value, $10,381.

Number of timber sales, classified according to amount of sale, fiscal year ended June 30, 1921.

State.	$100 or under.			$101–$500.	$501–$1,000.	$1,001–$5,000.	Over $5,000.	Total.
	Commercial.	Cost.	Total.					
Alabama	4	.....	4	.....	.....	.....	.....	4
Alaska	211	.....	211	1	3	4	2	221
Arizona	646	308	954	3	3	4	1	965
Arkansas	30	95	125	4	3	.....	1	133
California	484	322	806	20	5	12	7	850
Colorado	517	253	770	5	5	10	1	791
Florida	30	.....	30	3	6	2	.....	41
Georgia	42	.....	42	1	1	2	.....	46
Idaho	757	958	1,715	17	4	14	9	1,759
Michigan	3	3	6	.....	.....	.....	.....	6
Minnesota	4	.....	4	1	2	5	.....	12
Montana	773	1,514	2,287	22	7	13	7	2,336
Nebraska	3	.....	3	.....	.....	.....	.....	3
Nevada	71	9	80	.....	.....	.....	.....	80
New Hampshire	144	.....	144	.....	1	1	1	147
New Mexico	672	668	1,340	4	3	5	2	1,354
North Carolina	144	.....	144	2	.....	.....	.....	146
Oklahoma	22	.....	22	.....	.....	.....	.....	22
Oregon	326	534	860	16	5	8	5	894
South Dakota	348	180	528	4	2	1	1	536
Tennessee	58	52	110	.....	1	.....	.....	111
Utah	337	610	947	7	1	2	2	959
Virginia	297	13	310	2	1	.....	2	315
Washington	328	132	460	8	5	13	4	490
West Virginia	26	.....	26	.....	.....	1	.....	27
Wyoming	171	137	308	6	3	4	1	322
Total, 1921	6,448	5,788	12,236	126	61	101	46	12,570
Total, 1920	7,182	5,580	12,762	141	84	174	111	13,272

REFORESTATION.

The details of planting and sowing operations are given in the following table:

Planting and sowing on National Forests, by States, 1921.

State.	Area planted.	Area sowed.	Total.	State.	Area planted.	Area sowed.	Total.
	Acres.	*Acres.*	*Acres.*		*Acres.*	*Acres.*	*Acres.*
Michigan	908.80	.....	908.80	Virginia	61.67	.....	61.67
Montana	885.20	.....	885.20	Alabama	8.00	.....	8.00
Colorado	848.75	.....	848.75	Florida	.....	5.00	5.00
Idaho	801.80	.....	801.80	New Hampshire	3.50	.....	3.50
Minnesota	732.50	.....	732.50	Arizona	2.00	.....	2.00
Nebraska	431.25	.....	431.25				
Washington	410.00	.....	410.00	Total	5,500.47	5.00	5,505.47
Oregon	407.00	.....	407.00				

The decrease in the appropriation for planting and sowing denuded areas on the National Forests from a prewar total of over $170,000 to $125,640 and the high cost of labor during 1921 are both reflected in the decreased acreage planted and sowed. The scale on which this work can be conducted with the available appropriation is small compared with the need. There are at least 1,500,000 acres of old burns within the National Forests, denuded chiefly before the creation of the Forests, which can only be restored to productivity

by planting. At the present rate its reforestation will require at least 200 years. The work is at present concentrated in those regions where the greatest success is obtained and where the need for artificial reforestation is greatest. For example, the notably successful plantations on the National Forests in Michigan and Minnesota are being extended, while the work in New Mexico, Utah, and California has been suspended. Work in other regions is being conducted on a necessarily reduced scale.

RANGE.

GENERAL CONDITIONS.

After the unusually severe winter of 1919–20 and the cold, backward spring of 1920 live stock throughout the entire West were in very poor shape; but, except in the extreme Southwest and some parts of the Northwest, the summer rainfall was timely and sufficient, stock fattened rapidly, and the calf and lamb crops for the year were fairly satisfactory. Throughout the Northwest and the Rocky Mountain region storms drove the stock from the higher ranges somewhat earlier than usual, but their owners were prepared to take care of them. A very mild winter in these regions was followed by excellent conditions last spring. More hay than usual was carried over, while the conditions for its production during the summer of 1921 were of the best. In fact, in every part of the West there are good prospects for cheap hay for feeding during the winter of 1921–22.

In Arizona, New Mexico, and southwestern Colorado, however, the entire summer of 1920 was extremely dry, and the stock went into the winter of 1920–21 in poor condition. An unusually light snowfall was followed by a very dry spring, with high winds, and the drought of the previous year continued. Watering places dried up, forage was very short, and by the first of July, 1921, the situation was deplorable. Subsequently, however, heavy rainfall saved the day. At the end of September grazing conditions in the Southwest were excellent, and most of the stock will undoubtedly enter the winter of 1921–22 in good condition.

USE OF THE RANGE.

The following table shows the number of stock on the National Forests under permits for the fiscal year 1921:

Grazing permits issued and number of stock grazed, 1921.

State.	Cattle, horses, and swine.				Sheep and goats.		
	Permits issued.	Number of stock grazed.			Permits issued.	Number of stock grazed.	
		Cattle.	Horses.	Swine.		Sheep.	Goats.
Alabama	9	213	.....	.....	.....	.....	.....
Arizona	1,455	351,622	4,044	530	144	312,227	4,030
Arkansas	224	3,159	46	51	2	12	48
California	2,831	204,341	6,064	1,133	504	544,832	9,391
Colorado	4,561	368,716	8,667	12	806	987,327	1,156
Florida	32	959	2	154	2	1,009	.....
Georgia	74	596	22	45	3	9	12
Idaho	4,061	176,457	12,537	.....	996	1,634,610	.....
Montana	2,814	158,341	13,474	.....	495	690,888	100
Nebraska	37	6,001	501	.....	.....	.....	.....
Nevada	500	72,963	3,439	.....	137	344,419	.....
New Hampshire	18	174	38	.....	.....	.....	.....
New Mexico	1,925	170,154	3,495	414	543	384,144	28,357
North Carolina	363	1,960	71	553	29	355	.....
Oklahoma	43	1,953	109	.....	.....	.....	.....
Oregon	2,360	153,595	8,340	56	540	734,420	96
South Dakota	805	35,492	2,699	.....	4	2,200	.....
Tennessee	48	316	.....	.....	6	150	.....
Utah	6,942	162,153	8,048	228	1,796	800,672	.....
Virginia	245	2,346	4	.....	5	132	.....
Washington	947	28,295	2,768	.....	152	201,297	.....
West Virginia	7	35	.....	1	1	9	.....
Wyoming	1,259	150,874	4,503	.....	375	773,700	.....
Total, 1921	31,560	2,050,715	78,871	3,177	6,540	7,412,412	43,190
Total, 1920	31,301	2,033,800	83,015	4,066	6,199	7,271,136	53,685
Increase	259	16,915	.....	.....	341	141,276	.....
Decrease	.....	.....	4,144	889	.....	.....	10,495

FINANCIAL CONDITION OF STOCK INDUSTRY.

The stockmen using the National Forest ranges have felt severely the serious economic depression of the past year. This situation is a part of the generally adverse conditions affecting all agricultural industries throughout the country. Cattle prices were very disappointing. In the Southwest, where a large number of young steers are annually shipped from the Forest ranges, many owners were unable to find purchasers at any price. As a result spring deliveries from many localities for 1921 were much smaller than usual. Several shipments of range cows which went to market from various points in the West were reported to have brought less than the freight, and in a number of other instances netted the owners but $1 or $2 a head.

On the whole, sheepmen have suffered more than cattle producers from the present depression in live stock in consequence of the staggering drop in wool prices. Fairly satisfactory prices for the spring lamb crop of 1920 was the only encouraging factor. Financial conditions forced the sheep owners to sell down closer on their lamb crop than for many years past, so that the carry over includes fewer young ewes than normal. In spite of the depression in the sheep business, many stockmen are changing from cattle to sheep. Low prices for stock sheep offer a favorable opportunity to get into the business, while the returns from sheep, coming twice a year, make it more attractive.

POSTPONEMENT OF GRAZING FEES.

In order to make certain that each range will be used every year and as a necessary requirement in the disposal of public resources of commercial value, the regulations of the department require that all grazing fees be paid at least 30 days before the opening of the grazing season. The financial stringency appeared to justify an exception to the rule this season, and early in February, 1921, the Forest Service recommended to the Secretary of Agriculture its relaxation. Congress, with the favorable recommendation of the Secretary of Agriculture, passed an act authorizing postponement to September 1 of the payment of all grazing fees for the calendar year 1921. As the season advanced, however, it became evident that many stockmen would not be able to meet their obligations on that date, and further legislation was enacted, extending the time of payment to December 1, so that permittees might secure funds through marketing their surplus stock at the end of the season. The amount involved in this postponement is shown in the following table:

Grazing fees, paid and postponed, fiscal year 1921.

District.	Total paid, by classes of stock, to June 30, 1921.		Total paid to June 30, 1921.	Total unpaid, by classes of stock, on July 1, 1921.		Total unpaid on July 1, 1921.	Total receipts for fiscal year 1921 if all were paid.
	Cattle.	Sheep.		Cattle.	Sheep.		
1	$46,344	$23,266	$69,610	$74,329	$53,072	$127,402	$197,013
2	46,961	10,171	57,132	250,520	126,602	377,120	434,252
3	63,350	11,817	75,167	412,910	105,499	518,409	593,576
4	65,756	35,579	101,335	268,736	312,066	580,803	682,138
5	57,365	29,955	87,320	94,938	53,745	148,683	236,003
6	35,778	15,584	51,362	111,341	94,582	205,924	257,287
7	9,557	128	9,685	5,509	154	5,664	15,349
Total	325,111	126,500	451,611	1,218,283	745,720	1,964,005	2,415,618

TOTAL RECEIPTS.[1]

	Cattle and horses.	Sheep and goats.	Total.
Fiscal year 1921 if all are paid	$1,543,394	$872,220	$2,415,618
Fiscal year 1920	1,549,390	877,638	2,427,028

[1] Grazing trespass fees not included.

The use of the range in the fiscal year 1921, as shown by the table on page 23, was apparently greater than in the fiscal year 1920, while the total of the fees, paid and unpaid, is shown above as less. The discrepancy is caused by the fact that the fiscal year is an artificial and confusing time division to use in statistics relating to use of the National Forest ranges. The accident of a late or early season or the financial circumstances of individual stockmen may cause a shifting of the date on which the stock enter the Forests or on which receipts are credited sufficient to make accurate comparison of two succeeding fiscal years impossible. For this reason as well as to lessen the burden now imposed on the field force by the necessity of making up statistical reports in the midst of the field season, with its many demands on their time, the figures showing use of the range will in future be given by calendar instead of fiscal years.

RANGE APPRAISALS.

The field work necessary for appraising the value of the National Forest live-stock ranges under the plan announced in last year's report was begun. The objective is an accurate classification of each range unit, based on the character of forage, the water supply, topography, nearness to shipping points, ease with which stock can reach them, and other factors affecting their grazing value. A uniform charge is now made for the use of all ranges within a Forest or group of Forests. Some range allotments, however, are worth far more than others. The work now under way will make it possible to base the grazing fees for each particular range unit upon its actual value to the stockmen.

The five-year grazing permits now in effect do not expire until the close of the grazing season of 1923. Consequently no change in the grazing fees can be fairly put into effect before the grazing season of 1924. Good progress is being made with the classification project, and the Forest Service is now sanguine of being able to complete the field work, review the assembled data, and arrive at a decision by that time. The permittees are cooperating with the Service in its field study, and before final action is recommended the stockmen, through their advisory boards, will be given full opportunity to present their views, evidence, and arguments on the fairness of the fees contemplated.

NEED FOR MORE GRAZING EXPERTS.

Each season accentuates the urgent need for more grazing experts. First among the reasons is a demand for grazing privileges far in excess of the carrying capacity of the ranges. This demand is steadily increasing in volume and insistence. Stockmen who for many years grazed their animals on the public domain now find their accustomed ranges so cut into by grazing homesteads that they are forced either to secure grazing privileges on the National Forests, to purchase private lands, or to go out of business. Many of the larger companies were farsighted enough to invest heavily in grazing lands as a protection against the loss of their public domain range; but the economic transition which the open range live-stock industry is passing through is causing the average stockman no little concern. This comes at a time of great financial stress. It is therefore doubly desirable that the full carrying power of the National Forest ranges be quickly developed. But these ranges have just passed through a severe emergency period. During the war some of them were overstocked to meet the need for increased food production, with the understanding that the increases allowed were merely temporary. Other ranges were overgrazed because the force of trained grazing business experts was depleted during the war period. Such temporary overstocking and overgrazing must be remedied before the numbers of stock can be further increased.

Overgrazing follows the lack of proper application of specialized knowledge as to the character of the range itself, its true carrying capacity, the class of stock for which it is best fitted, the seasons during which the stock should properly be on the range, and similar matters. Aside from the fact that the rangers and supervisors are

already so loaded with other administrative duties that they usually can not make the close study and investigation of the ranges necessary for their full development and most beneficial use, such work must be done by specially trained men. Without them the devising and application of sound, far-reaching plans of grazing management is impossible. The benefits of such plans are large in volume and quickly realized. Every dollar invested in them brings the Government a good return. Over and over this has been proved either by the increased number of stock carried after the plans are applied or by the possibility of maintaining without injury a volume of use which previously resulted in overstocking. The increased receipts for grazing thus secured do not stop with one season, but continue year after year.

The stockmen who have seen the splendid results where it has been possible to carry on this work, are naturally anxious to have it extended because of its benefits to the live-stock industry. The future of the live-stock industry in the West, especially that of sheep grazing, is closely tied up with the National Forest ranges. In addition to their direct use, they have great value as object lessons. Nearly all the holders of large grazing areas in the West, such as railroad and land companies, are now attempting to handle their ranges along the same lines as does the Forest Service. Its methods are constantly being studied and adopted, to the benefit not only of the landowners but also the stockmen and, indeed, the general public. In short, the work that is being done by the grazing experts of the Forest Service is of a permanently constructive character. By it the carrying capacity of the National Forest ranges, which has been markedly increased over their carrying capacity as parts of the public domain, is being still further augmented. To graze successfully three head of stock where two grazed before is equivalent to increasing the area of our range by 50 per cent. There is every reason for expanding the grazing investigations upon which depend expert range administration, and increased funds for this purpose are justified alike on grounds of sound economics and of good business practice.

RECREATION AND GAME.

Outdoor recreation ranks to-day as one of the major resources or utilities of the National Forests, not because of anything the Government has done to facilitate or increase this form of use, but because of the demonstrated belief of several millions of people that the Forests offer a broad and varied field of recreational opportunity. The presence of large numbers of people on favored recreation areas creates problems of sanitation, of public health, and of protection of public property which can not safely be ignored.

Counties, municipalities, forest recreation associations and other semipublic organizations, and in some cases individual citizens are doing much by generous donations and constructive planning to relieve the situation. They have installed toilets, fireplaces, shelters, sources of water supply, tables and benches, refuse depositories, parking places, and other almost indispensable facilities. Many camp grounds have thus been developed in comfort and beauty far beyond the standards the Government would seek to attain. The Cajon Pass Camp Ground, on the Angeles National Forests in southern

California represents investments of private funds amounting to over $25,000, a sum almost equal to the entire amount of official funds expended for comparable work on all the National Forests. Several municipal camps are examples of the high public service which campground improvements promote.

After the fullest possible cooperation has been secured, however, there will remain many important recreation areas where action by the Government will be necessary to preserve public health and property. The people can not be excluded from the Forests, and conditions endangering their health and that of others can not be regarded with indifference. The Government should install necessary sanitary and protective facilities upon camp grounds where other means of improvement are unobtainable. The estimate submitted of $10,000 to meet the cost of work of this kind during the fiscal year 1923 is but a tithe of the amount needed, but it will provide for a few of the most urgent cases.

The full recreational development of the National Forests, however, should not depend wholly upon public action. Private initiative and capital will no doubt furnish the public with some of the facilities it needs, under the encouragement of reasonable terms and with acceptance of reasonable limitations. Much of the recreational resource may properly be made available for commercial development under conditions safe-guarding the public against poor service, discrimination, or extortionate charges. Rentals derived from occupancy under permit of National Forest lands constitute a permanent and rapidly growing source of income. In course of time the innumerable nooks and corners within the Forests which may be devoted to special uses will return a revenue largely reimbursing the costs of administration and improvement. Even under present conditions this activity is more than self-supporting.

In general, there is a broad competition between industrial and recreational uses, and within the latter class competition exists between one form of use and another. The relative public importance of various forms of special use to which a given area may be adapted or devoted must be ascertained and defined so that major values shall not be sacrificed to minor ones. The inherent values of Forests or parts of them must be studied and plans of land occupancy formulated which will conserve the maximum utility of the areas. The actual work of construction must be supervised. These duties demand the specialized skill and training of competent recreation engineers, under whose direction the occupancy of Forest lands under special-use permits could be better coordinated with other forms of use and made more permanent and effective. It is regrettable that funds are not available for the employment of a limited number of men of this class.

The use of the National Forests as the habitat of wild game is of considerable public importance. The presence of game adds to their attractiveness not only to hunters but to occupants generally, and anything that contributes to the abundance and variety of game increases the value of the Forests for public purposes. The same thing applies to fish in the Forest streams. The Forest Service has a corresponding duty and obligation. It cooperated during the year with the Biological Survey, the Bureau of Fisheries, and State authorities in fish and game matters.

Game in the National Forests presents a combination of problems—biological problems, legal problems, and range problems. The latter apply particularly to the larger ruminants, such as moose, elk, and deer. The most important range problem arising through the presence of game in the National Forests is in the immediate vicinity of the Yellowstone National Park, where about 1,650,000 acres are devoted primarily to the protection of elk herds, whose range, particularly during the summer, is largely within the park. Lack of winter range during unfavorable years has played havoc with these herds. In contrast with the severe winter and heavy losses of 1919–20 the winter of 1920–21 was open, the feed upon the winter elk ranges more than ample for their needs, and the elk wintered in fine shape. The spring of 1921 was favorable for the crop of young elk calves, which, from all information, was unusually good; and, as the summer of 1921 was one of fine forage growth, the losses among the calves were very slight. In all probability this fine calf crop will go a good way toward filling up the ranks of the combined herds, which were depleted by the losses of the winter of 1919–20. Both the Jackson Hole herd and the northern herd have had a favorable year. The latter herd remained well within the boundaries of the Yellowstone National Park until late in the season. Probably not more than 150 elk were killed by hunters last fall along its entire northern boundary. This gain has been supplemented by an almost complete stop of the inroads on the herd by poachers and tusk hunters through a winter patrol along the northern boundary of the Yellowstone National Park by officers of the Forest Service during the last four seasons.

But the stopping of poaching and one good season do not solve the problem, which is essentially one of winter range. Some provision, though inadequate in amount, was made years ago by the Federal Government for the Jackson Hole herd through purchases of hay and through additions to the Forest under authority of Congress; but the northern herd is left with a most unsatisfactory winter refuge.

To meet this situation the remaining public lands lying along the Yellowstone River and between the Absaroka and Gallatin National Forests should be added to these Forests. The lands are now under Executive withdrawal in response to the urgent recommendation of the Forest Service, the Biological Survey, and the National Park Service, but action by Congress is necessary to make the addition. Use of these lands for winter range for the elk must take into fair consideration the needs of local settlers for range for domestic stock. The Service has increasingly urged early action by Congress to the end that the addition may be made, so that the elk may be safeguarded against annihilation during some unfavorable winter, while at the same time the range of the local stockmen may be adjusted to the new order without resulting hardship.

One of the outstanding requirements for the perpetuation of the game resources of the National Forests is a considerable number of small, well-distributed game refuges, within which the rapidly diminishing stocks of valuable mammals and birds may rear their young free from molestation, thus maintaining upon the surround-

ing lands a normal overflow or drift to supply the hunter, naturalist, and lover of the wild. The National Forests contain many areas remote, inaccessible, and largely unsuited for the grazing of domestic stock, which might advantageously be devoted to this purpose. The dedication of such areas to the protection of game would be purely a function of land management, the State's control over the game being unaffected. Several excellent bills are now pending in Congress. A law of this kind, generally applicable to all National Forests, should be enacted.

Supplementary to the establishment of suitably located game refuges which would serve as breeding places, there should be definitely formulated plans for wild-life administration. In developing such plans the Forest Service looks to the Biological Survey for expert advice and assistance, just as it looks to the Bureaus of Entomology and Plant Industry for aid in protecting the National Forest timber supplies against insect infestations and tree diseases. The animal life of the Forests—that is, their native population, beast, bird, and fish—should be regarded and handled in precisely the same way as their plant life—their tree growth and forage growth. Under skillful management the quantity produced can be increased, its kind regulated, and its most desirable utilization secured. The wild life of the Forests has various kinds of values—material, esthetic, scientific, educational. All should be recognized. Unregulated use means its impairment; intensive use, often its eventual destruction as a resource. Expert knowledge of all the factors that determine its amount and character on a given area, combined with a just appraisal of all the human services and values realizable from it, are fundamental requisites for its proper administration.

Both the propagation and utilization of wild life can then be provided for. Much greater progress has been made toward an intelligent handling of fish in the Forests than of game and fur-bearing animals. It is certain, for example, that beaver could be bred in far greater numbers than at present, could be restricted to localities where they would not be detrimental to agriculture, and could be made a source of revenue of considerable importance. Their multiplication under a wisely worked-out plan might be made to increase the quantity of water available for irrigation, while trapping their natural increase might become a valuable privilege for those living in or near the Forests. Obviously a balance should be maintained between production and utilization, once a locality has become as fully stocked as, all things considered, is desirable. Obviously also there must be correlation between the management plans of the Forest Service having in view the best handling of National Forest wild-life resources and State laws relating to game and other forms of wild life. Already legislation of a character making this possible has been enacted in some States.

WATER POWER.

The Federal water power act of June 10, 1920, restricted the authority of the Secretary of Agriculture on water power matters to the administration of permits under the act of February 15, 1901, and of transmission line easements under the act of March 4, 1911, granted prior to the passage of the Federal water power act. This

act has been interpreted to mean that the Secretary of Agriculture may revoke privileges granted under the two earlier acts, may extend the period for completing construction and beginning operation of projects under final power permit issued under the act of February 15, 1901, but may not grant extensions of time under preliminary power permits, transfer any permit from the permittee to some other company, or permit the use of lands outside the right of way covered by the final permit. Because of the greater security of tenure given by the Federal water power act, its enactment was expected to lead to many applications for the substitution of licenses under it for final power permits issued under the act of February 15, 1901. No applications of this kind were received during the fiscal year. This probably is because permittees wished first to understand fully what regulations would be issued under the Federal water power act and how the law and regulations may affect power developments. Consequently there were in effect on June 30, 1921, all of the permits or easements granted by the Secretary of Agriculture except those final power permits which have been relinquished or revoked and those preliminary permits which had expired through failure to file final application within the specified time. The following tabulation presents data concerning them:

Water-power development and transmission-line rights of way under permit or easement fiscal year 1921.

Class of permits or easements.	Transmission lines only.			Power projects (reservoirs), conduits, and power houses.		Total number permits or easements.
	Number of permits or easements.	Length in miles.		Number of permits or easements.	Estimated average output (in horsepower) at minimum discharge.	
		Within National Forest boundaries.	On National Forest land.			
Permits or easements in force at close of fiscal year:						
Rental—						
Preliminary				9	190,579	9
Final	151	1,152.98	878.65	89	682,071	240
Free permits or easements	23	154.33	126.84	99	26,764	122
Total	174	1,307.31	1,005.49	197	899,414	371
Construction completed at close of fiscal year:						
Rental permits or easements	150	1,067.88	805.22	74	346,150	224
Free permits or easements	23	154.33	126.84	84	7,216	107
Total	173	1,222.21	932.06	158	353,366	331
Construction incomplete at close of fiscal year:						
Rental permits or easements	1	85.10	73.43	16	332,015	17
Free permits or easements				14	16,965	14
Total	1	85.10	73.43	30	348,980	31
Constructed not started at close of fiscal year:						
Rental permits or easements				8	197,053	8
Free permits or easements				1	15	1
Total				9	197,068	9

While it was anticipated that the Federal water power act would bring about a great revival of interest in power development, the applications filed are far in excess of all expectations. One of the interesting features has been the amount of proposed development in Alaska. Twenty-five applications, involving capacities of 180,000 horsepower, were filed during the year. Of these, 12 projects, with a total capacity of 130,000 horsepower, as estimated by the applicants, are intended to be used in the manufacture of pulp and paper, from timber to be obtained almost exclusively from the National Forests. Of 229 applications received by the Federal Water Power Commission for projects which the applicants estimate as having a capacity of 14,669,800 horsepower, 124 applications of 3,706,225 horsepower were for projects within or partly within the National Forests. The amount of proposed development in California is astonishing; 71 applications, involving 3,128,680 horsepower, were filed, of which 62 applications, involving a development of 3,081,765 horsepower, are located within, or partly within, the Forests.

The Federal water power act provides that the work of the power commission shall be performed by the three Departments of War, Interior, and Agriculture, and their engineering, technical, clerical, and other personnel, except as may be otherwise provided by law. It has been necessary for the three departments not only to loan employees to the power commission for work in Washington, but also to make all field investigations and reports and to hold all hearings except the few that could be handled by the commission itself at Washington. At the end of the fiscal year the Department of Agriculture was loaning 11 employees to the power commission, five of whom were from the Forest Service, entailing a charge against the Forest Service appropriations of more than $1,000 a month. In the field districts also much time is required from Forest officers. Water-power work cost over twice what it did the year before, and will evidently cost still more this year. Relief from this burden is greatly needed. Either the commission should be authorized to pay the salaries of the employees engaged upon its work or the appropriations of the departments paying but not utilizing them should be correspondingly increased.

ROADS, TRAILS, AND OTHER IMPROVEMENTS.

The active prosecution of road and trail work, largely stopped during the war and started anew in 1919, was continued. The year witnessed the peak of high prices. This and a scarcity of efficient labor made impossible the construction of as many miles of road with the available money as was planned. The average cost of road and trail construction, repairs, and maintenance was about 70 per cent higher than in 1919. In the late fall costs decreased slightly, labor increased in efficiency, and contractors were more desirous to get work. This change grew more pronounced during the winter, and last spring contracts were let at amounts materially less than the engineering estimates. Unemployment conditions are indicated by the great increase in the number of contractors now submitting bids.

The following tabulation shows the mileage of roads and trails constructed, repaired, and maintained during the calendar year 1920,

the total mileage at the end of the year, the total expenditure to date, and the amounts expended from the Forest road appropriations and from cooperative funds. These figures include major work handled under the immediate supervision of the Bureau of Public Roads as well as the comparatively simple work done directly by the Forest Service.

Construction, improvement, and maintenance of roads and trails from Forest road appropriations and other Federal and cooperative funds by States.

State.	Calendar year 1920.		Total to Dec. 30, 1920.		Expenditures to Dec. 30, 1920.		
	Roads.	Trails.	Roads.	Trails.	Federal.	Cooperative.	Total funds.
	Miles.	*Miles.*	*Miles.*	*Miles.*			
Alabama					$218.28		$218.28
Alaska	37.5	3.8	84.7	15.1	369,489.60	$86,787.16	456,276.76
Arizona	95.3	141.4	244.9	204.5	591,938.72	363,243.36	955,182.08
Arkansas	21.5	4.5	69.7	17.4	187,432.64	24,607.57	212,040.21
California	68.7	213.7	304.8	410.5	1,539,163.84	426,257.19	1,965,421.03
Colorado	89.8	69.9	253.5	239.3	1,176,149.36	323,005.82	1,499,155.18
Florida	3.5		53.0		60,442.75	58,030.00	118,472.75
Georgia	1.0	11.5	1.0	13.0	10,670.93	2,000.00	12,670.93
Idaho	250.8	342.0	712.9	518.4	1,523,123.10	574,571.26	2,097,694.36
Kansas			3.4		2,111.51		2,111.51
Maine		8.0		30.0	5,508.80		5,508.80
Michigan	2.4		33.3		1,512.67		1,512.67
Minnesota	3.0		8.4		55,946.64	13,997.87	69,944.51
Montana	104.9	97.3	365.1	136.9	1,010,070.20	283,245.42	1,293,315.62
Nebraska	3.8		7.4		7,208.81		7,208.81
Nevada	27.4	41.5	170.9	90.0	148,512.61	88,481.23	236,993.84
New Hampshire		9.0	5.0	211.8	12,250.47	220.25	12,470.72
New Mexico	78.6	209.1	178.2	343.0	636,222.56	137,761.58	773,984.14
North Carolina	4.0	12.8	4.0	31.0	75,689.64	2,499.82	78,189.46
North Dakota			1.0		65.75		65.75
Oklahoma					3,916.48	1,811.25	5,727.73
Oregon	275.4	131.4	753.0	307.1	1,184,802.48	864,068.97	2,048,871.45
Porto Rico		4.0		20.0	2,396.13		2,396.13
South Carolina					68.13		68.13
South Dakota	20.0		44.0	3.0	139,854.30	58,470.39	198,324.69
Tennessee	3.7	15.5	3.7	15.5	23,003.97	20,497.41	43,501.38
Utah	155.6	210.0	554.8	485.0	666,452.13	364,502.96	1,030,955.09
Virginia	1.5	29.5	4.0	50.5	21,781.85	2,409.91	24,191.76
Washington	116.0	110.3	234.7	284.0	959,886.13	618,135.04	1,578,021.17
West Virginia					772.42		772.42
Wyoming	80.2	102.6	229.1	220.0	623,334.17	111,244.56	734,578.73
Total	1,444.6	1,767.8	4,324.5	3,647.0	11,039,997.07	4,425,849.02	15,465,846.09

The following tabulation indicates the condition of the three road appropriations on January 1, 1921:

Condition of road appropriations.

Fund.	Total appropriations to Dec. 31, 1920.	Total expenditures.	Unexpended balance.
"10 per cent" [1]	$2,794,251.21	$2,161,482.24	$632,768.97
"Section 8" [2]	5,000,000.00	3,222,240.43	1,777,759.57
"F. F. R. C." [3]	9,000,000.00	5,167,519.77	3,830,697 23
Total	16,794,251.21	10,551,242.44	6,243,008.77

[1] 10 per cent of the National Forest receipts of the previous year; made available by agricultural appropriation acts of Aug. 10, 1912, and Mar. 4, 1913.
[2] Made available by sec. 8 of the Federal-aid road act of July 11, 1916.
[3] Federal forest road construction fund; made available by sec. 8 of the Post Office appropriation act of Feb. 28, 1919.

The distribution among the States of the total appropriations and of the appropriations for the fiscal year 1922 is given in the following tabulation:

The distribution among the States of the total appropriations and of the appropriation for the fiscal year 1922.

State.	10 per cent fund.[1]		Section 8 fund.[2]		Total Federal forest road construction.[3]	Total.
	Fiscal year 1922.	Total.	Fiscal year 1922.	Total.		
Alabama	$78.69	$199.64	(B)	$60.00	$508.13	$767.77
Alaska	5,902.54	69,384.39	$44,587	284,610.57	172,736.50	526,731.46
Arizona	16,972.20	310,935.82	55,311	355,997.05	424,713.91	1,091,646.78
Arkansas	4,920.99	46,989.51	9,761	89,364.60	138,134.22	274,479.33
California	52,962.76	403,895.48	136,780	891,127.25	1,071,723.27	2,366,656.00
Colorado	17,141.75	202,139.96	64,258	435,718.31	737,714.87	1,465,573.14
Florida	1,504.54	13,824.92	(A)	56,955.67	23,834.40	94,614.99
Georgia	564.28	2,036.00	(B)	143.17	177,649.97	179,829.14
Idaho	27,417.88	347,508.22	110,773	680,780.59	1,245,811.68	2,274,100.49
Kansas	.....	1,977.32	.....	.....	.....	1,977.32
Maine	185.99	649.39	(B)	169.01	3,583.75	4,402.15
Michigan	217.08	719.39	(A)	15.00	3,000.00	3,734.39
Minnesota	1,363.73	13,221.65	(A)	511.65	98,721.76	112,455.06
Montana	19,070.81	324,815.27	70,182	452,548.32	701,655.36	1,479,018.95
Nebraska	59.54	9,290.81	(A)	26.98	.....	9,317.79
Nevada	2,542.73	75,826.50	18,689	121,160.45	100,710.08	297,697.03
New Hampshire	2,216.96	8,424.80	(B)	166.10	9,419.28	18,010.18
New Mexico	8,596.45	189,219.13	38,817	254,904.61	480,988.50	925,112.24
North Carolina	3,080.49	9,898.41	(B)	912.99	160,002.56	170,813.96
North Dakota	.....	156.79	.....	15.00	.....	171.79
Oklahoma	336.68	4,220.00	(A)	49.45	2,555.26	6,824.71
Oregon	29,282.72	316,370.48	128,661	821,834.77	900,349.06	2,038,554.31
Porto Rico	.....	3.70	(A)	15.00	2,816.13	2,834.83
South Carolina	58.66	255.28	(B)	60.00	508.13	823.41
South Dakota	6,272.17	60,060.11	7,964	50,744.24	73,888.09	184,692.44
Tennessee	1,782.69	5,857.12	(B)	59,166.39	27,051.20	92,074.71
Utah	7,265.56	185,863.61	39,956	268,287.26	457,061.90	911,212.77
Virginia	2,312.89	9,654.41	(B)	68,054.38	69,506.54	147,215.33
Washington	22,051.60	180,547.65	89,862	590,863.63	720,579.75	1,491,991.03
West Virginia	444.18	1,235.77	(B)	128.64	3,137.69	4,502.10
Wyoming	13,390.63	157,165.87	42,778	264,595.17	532,382.10	954,143.14
Group I (A)	.....	.....	12,049	12,049.00	.....	12,049.00
Group II (B)	.....	.....	29,572	29,572.00	.....	29,572.00
Special fund	.....	.....	100,000	209,392.75	.....	209,392.75
Equipment	.....	.....	.....	.....	183,244.65	183,244.65
Administrative expenses	.....	.....	.....	.....	143,779.91	143,779.91
Unallotted balance	.....	.....	.....	.....	332,231.35	332,231.35
Total	247,997.19	3,042,248.40	1,000,000	6,000,000.00	9,000,000.00	18,042,248.40

[1] 10 per cent of the National Forest receipts of the previous year; made available by agricultural appropriation acts of Aug. 10, 1912, and Mar. 4, 1913.
[2] Made available by sec. 8 of the Federal-aid road act of July 11, 1916.
[3] Federal forest road construction fund; made available by sec. 8 of the Post Office appropriation act of Feb. 28, 1919.

The plans for the calendar year 1921 contemplate work on about 700 miles of road and 1,800 miles of trail. This construction, together with plans, commitments, and obligations entered into which have not been consummated on account of unanticipated heavy advance in costs, will exhaust the unexpended balance of all road and trail appropriations already made with the exception of the 10 per cent fund, which must hereafter be devoted largely, if not exclusively, to trail maintenance work.

Plans have been drawn for a transportation system of roads and trails that will adequately serve the needs of the public and also the National Forests and encourage their development and utiliza-

tion. These plans include 39,000 miles of road and 74,000 miles of trail, of which 25,360 miles of road and 34,720 miles of trail have already been constructed, but upon which a considerable amount of relocation, reconstruction, and repair is necessary to make them safe and satisfactory for travel.

Many large areas are still entirely without even the simplest trail facilities. Valuable forests which will be urgently needed in the future are being jeopardized by reason of the fact that they are without adequate roads or trails by which fire-fighting supplies and men may be brought in in case of need. The primitive conditions existing on some of the Forests are but little realized. Many sections are entirely without roads, while others are served by roads which are simply wagon tracks through the woods, and are narrow, dangerous, steep, and entirely unsuited to travel.

This condition subjects great natural resources to grave and unwarranted risks. It increases our annual costs for fighting forest fires, increases our annual losses, and reduces the usefulness of the property protected. At the same time it retards local development, discourages the scattered settlers who can not build the roads they need unaided, reduces the value of their products and adds to the cost of their purchases, acts as a barrier against social intercourse and school privileges, adds to their isolation, and breeds discontent. The construction of National Forest roads and trails for the protection and development of the Forests should properly be viewed as an investment rather than an expense. To thus improve the public properties increases their value out of proportion to the sums invested, secures them against waste, and recognizes a civic obligation imposed on the Federal Government by extensive land ownership in a community.

During the past five years the average annual loss of National Forest timber by fire was approximately $1,500,000, and the cost of extinguishing fires about $1,200,000. An adequate system of roads and trails would materially reduce both items, would be of great public utility for general travel and traffic, and would further serve the public by lessening the destruction of resources essential to local prosperity. The system of transportation should be completed at the earliest practicable date consistent with other pressing public needs. Fires will not await our convenience. A number of measures are now pending which would make funds available for continuing the work upon a fairly adequate basis. Next to the integrity of the title to the soil itself, nothing more vitally affects the future of our National Forests.

RESEARCH.

SILVICAL INVESTIGATIONS.

The outstanding event of the year was the completion of plans for establishing on a small scale two new forest experiment stations, opened on July 1, 1921, and for reopening on the same date the station in the northern Rockies. In the development of national forestry such stations are fundamental. Their function is to secure the scientific basis necessary for the growing and protection of timber, alike on public and private lands. They can do this in the cheapest, quickest, most effective, and most authoritative way, for

they substitute systematic, well-directed research as a means of solving the problems of forest management, in place of slow progress by the method of trial and error. Hardly less will be their value as demonstration areas illustrating successful methods of timber growing.

We must know how to grow timber. Our industrial requirements are at least one-third those of the entire world, excluding fuel wood. Through forestry we must make up the present deficit between an annual drain of 26,000,000,000 cubic feet and a growth of 6,000,000,000. Reforestation of some 81,000,000 acres of devastated land is urgent; and so is application of methods of cutting which will insure continuous and full forest production on the rest of our timberlands, whether virgin or cut-over.

These things are impossible without better knowledge. The most effective methods of protection, particularly from fire, must be worked out. Growth and yields must be accurately known in order to regulate the cut rightly and afford owners a basis for a sound financial policy. Each species must be studied, as well as the natural laws governing tree growth, distribution, forest types, site values, climatic effects; in short, all that determines what can be produced on a given area, in what time, and at what cost. These in brief are the matters with which forest experiment stations are concerned. Their work is just as basic to successful forest production in the United States as is the work of agricultural experiment stations to better farming.

During the year three forest experiment stations were maintained, in Arizona, Colorado, and Washington, respectively, but each with only a one-man technical staff. Some progress was made in investigating such important subjects as brush disposal, natural reproduction, and nursery practice in the northern Rocky Mountain forests, methods of cutting in the Douglas fir and Engelmann spruce types of the central Rockies, methods of cutting, brush disposal, and regulation of sheep grazing in the western yellow pine forests of the Southwest, nursery practice and methods of planting in the Great Basin, and various phases of fire protection in California.

The establishment of new stations in the southern pine belt and the Appalachian Mountains is most opportune. The first must deal with problems on the forest area exceeding 115,000,000 acres, on which are chiefly dependent the lumber markets of the Central and Eastern States as well as the South. While it is now too late to prevent lumber production in the South from falling within a decade to a point where it will probably no more than equal local requirements, forest research should, if enlarged to an adequate basis, aid materially in increasing later production. In the Appalachians lumber production has fallen off 60 per cent in the last 10 years, yet the country must depend primarily upon this region for its future domestic hardwood supplies, and knowledge of methods of timber growing is urgently needed even now.

One well manned and equipped forest experiment station is needed for each of the important timber regions of the United States. This would require, besides the present stations in the Appalachians, the southern pine belt, the northern Rockies, Colorado, Arizona, and the Pacific Northwest, additional ones in the Northeast, the Alleghany Mountains, the Lake States, and California. These stations would

serve a total forest area of 463,000,000 acres, only 15,000,000 acres less than the total area of improved agricultural land in the United States. To the solution of the problems of this area, which in 1918 produced forest products of an aggregate value of $1,300,000,000, we are now devoting $85,000 annually. This provides for work on only a few of the most important and urgent problems of certain regions.

FOREST PRODUCTS.

Research in forest products, closely coordinated with the actual practice of forestry and with forest research along other lines, is fundamental for the solution of the national timber-supply problem. This work, centered mainly at the Forest Products Laboratory at Madison, Wis., seeks, on the one hand, extension of our existing timber supplies and reduction in the quantities which it will be necessary to produce to meet our future needs, and, on the other hand, furtherance of the practice of forestry through bringing about utilization along lines that will make forestry more widely remunerative. In other words, the primary purpose is to contribute toward bringing into balance production and consumption. Without provision for attacking this side of the forest problem of the country the work of the Forest Service would be hampered and its public usefulness seriously impaired.

As much wood decays in service each year as is destroyed by forest fires. Along some lines, as, for example, the treatment of railroad ties, there has been very material progress to which the Forest Products Laboratory has made important contributions. While approximately one-third of the ties of the country are now treated, the replacements on account of decay still take 2,000,000,000 feet of timber yearly. Again, one-sixth of the total lumber cut of the country is used in boxes. Laboratory investigations show that most boxes need to be redesigned and that as a rule stronger and more serviceable shipping containers could be produced from half or three-fourths as much lumber. Faulty construction also imposes on the public an annual charge of $110,000,000 for losses in shipment.

About one-tenth of the lumber cut is used for structural purposes where strength is a factor. The use either of unsatisfactory material or of unnecessarily large sizes results in waste. Through voluminous strength tests the laboratory is steadily developing a scientific basis for the amount and quality of timber actually needed to meet specific requirements. Large possibilities have also been shown for the use of new species for certain purposes; for example, eight instead of three species can now be satisfactorily used for hardwood distillation. Incidentally, it was found that the addition of a single cheap chemical increases the yield of wood alcohol by 50 per cent. Demonstration of the suitability of many American species for pulp and paper making, together with material contributions to the development of processes for the utilization of southern pine for both kraft and book papers, have already helped to relieve a comparatively small area and a limited number of species of the entire demand for pulpwood. These cases illustrate the ways in which forest products research work through the conservation of wood materials is a factor in solving the national timber supply problem.

An example of research which by making possible the utilization of waste material adds to the value of the forest crop and hence tends to make timber growing more profitable is afforded by the improved processes developed by the Forest Service for the conversion of southern pine sawdust into ethyl alcohol. Investigations which extend the number of woods that can be used for specific purposes may prove of the greatest value in stimulating forestry through increasing the market value of the crop. For example, the development of suitable preservative treatments should create or enlarge the market for ties of softwoods, such as the pines, and of some of the hardwoods, such as beech, birch, and maple, which now decay so quickly as to be comparatively useless for ties. Laminated or built-up wood is becoming increasingly practical, and its use may have a profound effect on the future methods of forestry by lessening the need for raising large trees. Even under present conditions the development of laminated construction will mean the profitable use of millions of feet of small material now wasted. A durable waterproof glue which will withstand all weather conditions will in itself open a great field for laminated products. The laboratory has been working intensively on such a glue during the past year, and has produced the most water-resistant glue now available.

Laboratory investigations of the future must deal more and more with second-growth materials as our virgin forests are exhausted. One investigation of the current year is designed to develop the most effective means of using the rapidly grown, knotty, second-growth pine of the Northeast for lumber and box making. Another important field for making forest-products research aid directly in the development of profitable forestry will be a systematic study of the inherent qualities and adaptability for particular uses of species which can be quickly and easily grown but now have little value. Striking examples of this sort are the extensive jack pine and aspen stands of the Lake States.

Forest-products research has also proved of great value in connection with the administration of the National Forests. Special research projects have been aimed directly at specific problems, general information has been made available on various questions, and technical advice has been supplied local wood-using industries dependent on the National Forests for material. The exact and satisfactory appraisal of National Forest timber has been greatly aided by intensive products studies of logging and milling methods and costs. In several of the western districts intensive studies of special utilization problems and also of the markets supplied partly by National Forest timber have been made; for example, of such important mining districts as Butte and Coeur d'Alene. These studies not only make it possible to meet current demands to best advantage but also serve as a partial basis for the management plans which are gradually being matured for the National Forest areas. The Forest Products Laboratory has conducted special studies to further the use of National Forest timbers; for example, the suitability of local species in Alaska for mining purposes, of southwestern species for construction purposes, and of some California species for citrus-fruit boxes were investigated. An investigation has been under way for the past year into the most effective spark arresters for locomotives,

donkeys, and logging engines, a problem of great importance because of the large number of forest fires which are the direct result of the use of unsatisfactory spark arresters. This means that the Forest Service, as it should, has in its own organization and at its command a corps of forest-products experts who have been and will continue to be used whenever they can aid in bringing about the most effective administration of the National Forests.

The most important new project undertaken by the Forest Products Laboratory during the year aimed at determining the practicability of cutting what is called "dimension stock," or the exact sizes to be used in manufacture by secondary wood-using industries direct from the log. Requirements of the secondary industries for wood in dimension stock sizes amount to 8,000,000,000 or 9,000,000,000 feet annually. Most of this material is now very wastefully cut out of standard lumber sizes after the lumber reaches the factory. It is estimated that in the furniture and wood-turning industries, which make as efficient use of their material as any of the secondary wood-using industries, 50 per cent of the lumber purchased is lost in various stages of manufacture under this system. The waste is not confined to the factories, but can be traced back to every process of transportation, seasoning, and milling, and even to logging, since small, crooked, and low-grade logs suitable for dimension stock, but not for lumber are now left in the woods.

This work has an unusual chance for success, because it is receiving the general support of both producers and consumers. The initial intensive studies are being confined to the chair and wood-turning groups, because both are of such a character as to lend themselves with comparative ease to standardization of wood stock requirements, and because in the latter group standardization work has already been carried far along by the National Association of Wood Turners. An immediate result of the study of waste in the secondary industries will be that the laboratory can bring the factories into closer touch with one another's wood requirements and can point out a market in one factory for the waste in another. In anticipation of this development the wood waste exchange established some years ago at Washington has been transferred to Madison.

FOREST ECONOMICS.

During the year State reports on the requirements of the wood-using industries in relation to forest resources were completed and are being published for New York and North Carolina in cooperation with the State authorities. A study was instituted in Michigan to determine in as exact a way as possible the economic effects of forest devastation, particularly from fires, on the various industries of the State. Some progress was made in compiling data on timber resources available for pulp manufacture in the Lake States and the Northeast, and also on timber resources of other countries with particular reference to its bearing on our own timber requirements. Statistical reports on lumber production in 1920, pulpwood consumption in 1920, and the amount of wood given preservative treatment were completed and published.

With the present discrepancy between a consumption of 26,000,000,000 cubic feet of timber annually and a growth of only 6,000,-

000,000, it is only a question of time when the country will face an acute timber shortage unless the right remedial measures are quickly found and applied. To work out the problems involved, a comprehensive timber survey is the first essential. Such a survey should, among other things, secure an inventory of the timber resources, their location, and availability for use. More accurate information is required as to the present and probable future requirements of the various wood-using industries. This must be supplemented by exact knowledge on the area of land available for forest production, on timber growth, and on the possibilities of increased yields under the practice of forestry. Only on the basis of such data can comprehensive plans to insure suitable supplies of satisfactory materials for our various requirements be formulated.

Depletion is not proceeding evenly, however. Some industries have an assured supply for some years to come, whereas in others the situation is already known to be acute. For example, handle makers, automobile manufacturers, and the vehicle and agricultural implement industries all compete actively for the remaining supplies of hickory and ash. Although the situation is serious, no one knows just what the remaining supplies are or how long they will last, and there is no basis for satisfactory plans as to supplies of raw materials for any of these industries. The same situation exists in the pulp and paper industry in the regions of its greatest concentration. The State of New York, for example, is now importing 54 per cent of the pulpwood consumed by its mills, and this mostly from Canada, where an assured future supply is seriously open to question. In Pennsylvania pulp and paper concerns are actually relogging areas cut over 20 years ago for hemlock to secure dead stubs, down logs, and even high stumps. These are merely two examples of acute timber shortages faced by special industries. Pending provision for a comprehensive timber survey much can be accomplished by securing more piece-meal information as to the amount, quality, and location of remaining supplies in comparison with present and probable future demands.

Along other economic lines there is also urgent need for information on which to base public and private policy in the development of forestry. The average length of haul for lumber and pulpwood and nearly all other forest products is rapidly increasing. Douglas fir from the Pacific coast is now going into our Atlantic coast markets, and pulpwood hauls of more than 750 miles are not uncommon. If the relationship between transportation and the costs and availability of lumber and other forest products were known in detail, both the importance and the profitableness of local timber production could be more accurately gauged.

Present forms of taxation are one of the most serious obstacles in the way of the growing of timber on privately owned lands. An annual tax is imposed on the timber crop during the entire period of its growth, which may be from 25 to 150 years or even more. A similar taxation policy for agricultural crops would lead to a tax assessment at intervals of a week or even less during the growing season. The taxation of forest land is a State function, but the States look to the Federal Government for guidance as to the best solution of the present situation. Unless the Federal Govern-

ment undertakes the investigations necessary to develop the most satisfactory methods of taxation for forest lands, the present conditions may continue for years to come. Studies of resources, transportation, and taxation merely illustrate the character of economic study which should be undertaken by the Federal Government in order to obtain the basis for a sound public policy.

RANGE INVESTIGATIONS.

Grazing investigations were severely reduced in a number of the districts to provide men for range appraisal. Other range investigations were heavily curtailed for lack of funds, although the series of droughts which have visited the entire western range country within the last three years have made the need for work of this kind greater than ever before. One of the most necessary studies is that relating to the time in the spring at which the stock should be turned upon the Forest ranges. Investigation on a few Forests where range deterioration was very marked showed conclusively that a large portion of the damage occurred through placing the stock on the ranges several weeks before the forage plants developed sufficiently to be grazed without injury to their growing capacity. It has been found on a number of Forests that the stock have been entering fully four weeks earlier than they should. Additional studies of this kind are badly needed as a basis for the fixing of proper grazing seasons which will insure maximum forage production.

Study of the distribution, forage values, and life history of the plants which make up the forage crop on the National Forest ranges was materially advanced during the year. Forest officers are making steady progress in acquiring essential knowledge of these matters. In California and Oregon the effect of burning brush areas on their grazing values was further investigated, with inconclusive results. In some cases additional vegetative growth of some value was secured, while in others the vegetation suitable for grazing was reduced. The question of erosion due to the burning off of the brush cover is a serious factor in the problem.

On the Jornada Range Reserve in New Mexico and the Santa Rita Range Reserve in Arizona the experiments in handling cattle in large numbers under purely open-range conditions are being continued with marked success. In that region the drought of several years, which was especially severe during the winter and spring of 1920–21, caused heavy losses to the live-stock interests in that region. On these reserves the average losses were from one-third to one-fifth of those on outside ranges, while calf crops were more than 50 per cent greater. As rapidly as possible the information gained through the management of these two range reserves is transmitted to the Forest officers handling the ranges on the National Forests with a view to giving the stockmen the benefit of the experiments.

The eradication of larkspur by grubbing was continued. About 15,850 acres have been practically cleared of this plant, which causes annually heavy losses to the cattle owners throughout the West. The total cost of this work to date is materially less than the annual saving to stock owners in reduced losses through larkspur poisoning on the areas cleared. With sufficient men and funds all the National

Forest ranges could be virtually cleared of larkspur within one or two seasons, and the losses, estimated at about $500,000 each year, could be almost entirely wiped out.

INFORMATIONAL ACTIVITIES.

Mention was made in last year's report of the establishment of a Branch of Public Relations. During the past fiscal year the organization of this branch was built up in the western districts as local conditions required and available funds made possible.

The chief function of public relations in the districts is to bring about more general cooperation of the public with the Forest Service for the prevention and control of forest fires, particularly on the National Forests. This is partly to reduce the cost of fire control and direct loss to the Government through fire damage, partly to prevent needless diminution of the timber supplies necessary to meet the economic needs of the country. These ends can be attained only as the users of the National Forests, the people living in and near them, and our citizens generally can be brought to realize that forest preservation is a matter of direct interest to them and that its accomplishment calls for individual care not to cause fires.

Effective utilization of the local Forest force to diffuse a better knowledge of the services of the forests, the need of public cooperation to prevent fires, and the methods necessary to pursue in order to prevent them is one of the important objects of the district public relations organization. Local publicity, enlistment of the interest of newspaper editors and civic and commercial organizations, talks in schools, the display in public places and the posting along roads and trails of suitable cautionary warnings and appeals, and the distribution to automobilists and others entering the Forests of windshield stickers, maps, and other literature or devices which help convey the lesson of care against fire are among the means used.

Where incendiary fires are of noticeable frequency the local situation is studied to discover the reasons and steps are taken to bring about better public sentiment. It is already manifest that a material reduction of the fire risk follows well-directed effort along the above lines. Obviously, its results are cumulative; its full benefits can be realized only through a continuous process of education carried on for a series of years; and the present situation necessitates the planning of expenditures and the use of time of the Forest Service personnel with a view primarily to immediate results and demands. Until more money is available, therefore, for the administration and protection of the National Forests much less can be done to prevent fires than the best interests of the public call for.

In the Washington office the informational activities include the supply of material for the use of the press service of the department, the preparation and use of exhibit material in cooperation with the departmental office of exhibits, the preparation of plans for obtaining and using motion pictures in cooperation with the corresponding departmental office, the gathering and use of illustrative photographs, the putting into final form of all official publications, the distribution of material relating to forestry suitable for school use,

cooperation with outside agencies through which useful knowledge of our forests, their service, their protection, and their best use can advantageously be disseminated, and similar lines of work. It is impossible, however, to utilize fully the opportunities open for advancing the practice of forestry along these lines. The demands of the press and the public for information and educational material are very heavy, and increasing as the importance of forest preservation is more widely recognized.

Forty-five new publications were issued during the year. The distribution of Forest Service publications totaled 342,745 copies. About 140 addresses were made, mainly at expositions and upon request from National Forest users, lumbermen's associations and similar trade bodies, technical societies, and education institutions.

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